APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

MAY, 1951

- HYDRAULIC CIRCUITS
- HYDRAULIC CONTROLS
- AIR CIRCUITS
- AIR CONTROLS
- ELECTRICAL AND ELECTRONIC CONTROLS

IN THIS ISSUE

PRINTING ON FILM WITH STEPLESS CONTROL

SIZES GO UP — PRESSURES GO DOWN

AIR COMPONENTS HELP YOU MEET TIGHT PRODUCTION SCHEDULES

PRESSURE LOSSES IN THE FLYING WING

FORM HOOKS FAST

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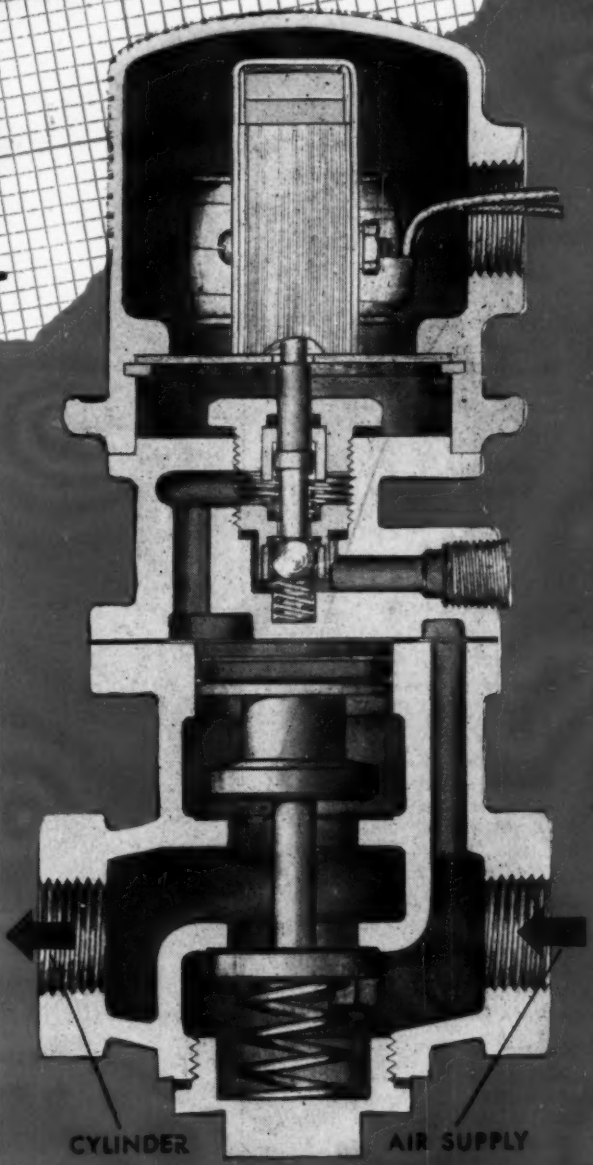

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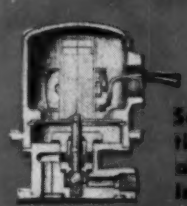

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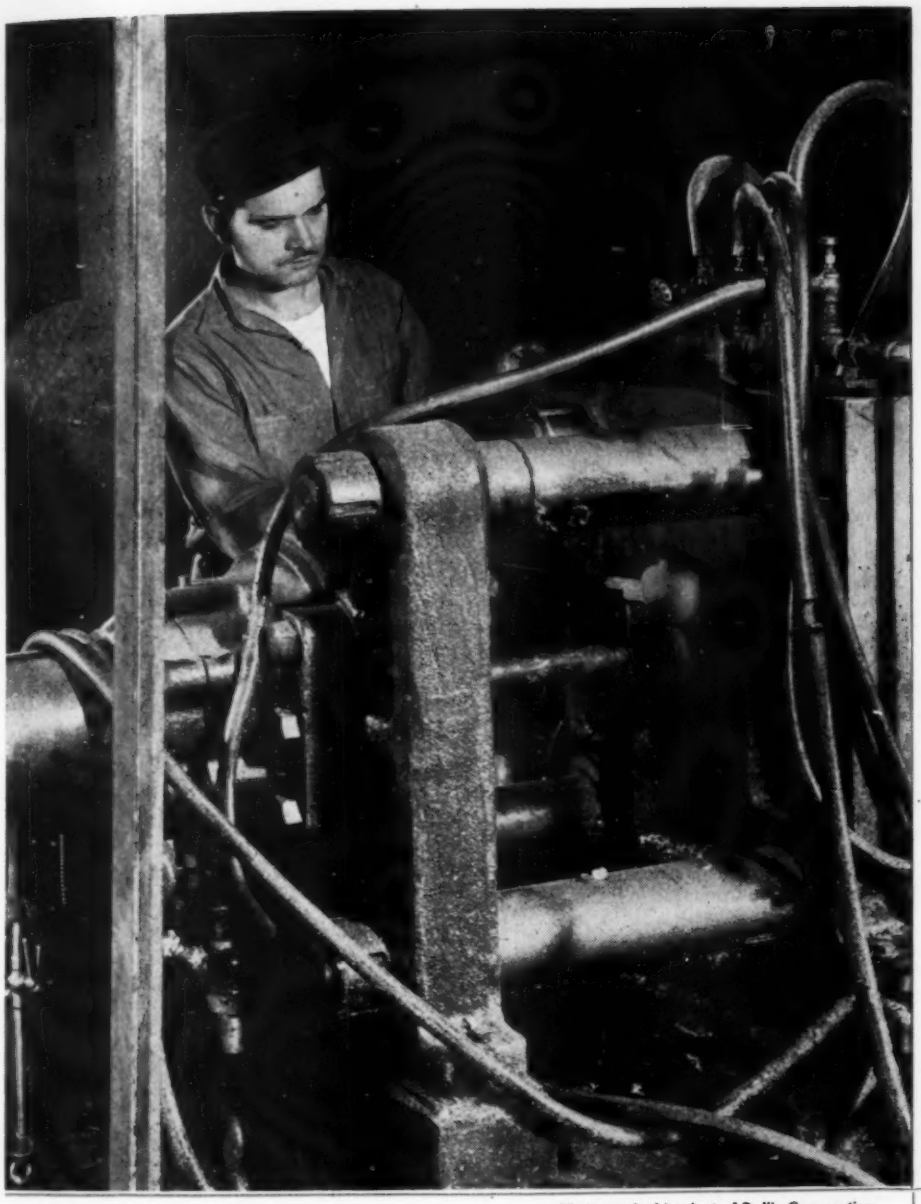

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Odor	Mild, pleasant
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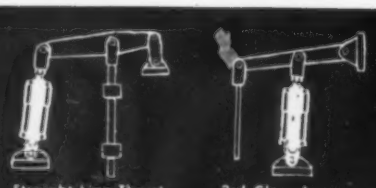

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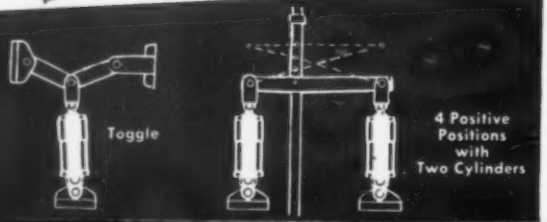

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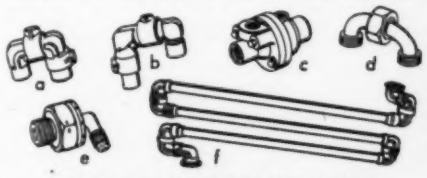

2 Brake line installation on torque link in aircraft brake system.

WRITE FOR CATALOG NO. 50-AH

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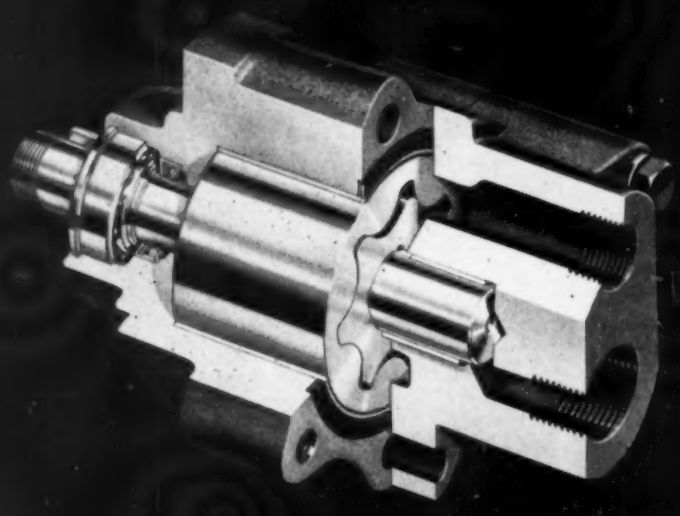

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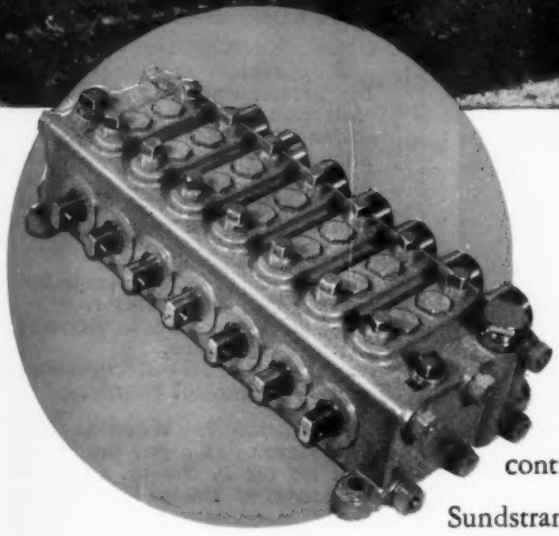

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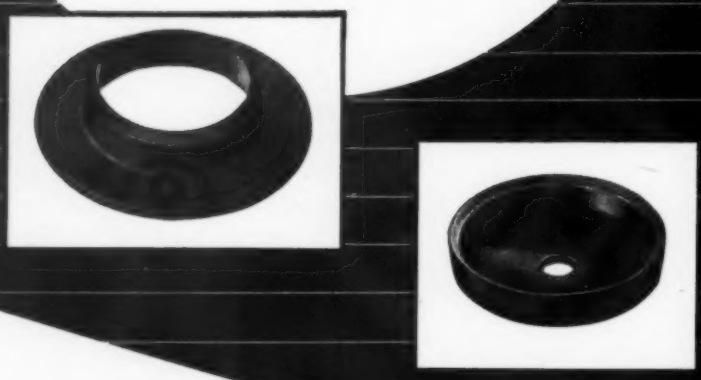

In dozens of special packing requirements, engineers specify Sirvis packings because they have been found to stand up longer under extreme pressure, friction and the action of hydraulic fluid. No other type of packings requires less replacement than Sirvis.

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LETTERS to the Editor

We are very much interested in the article by Mr. M. J. Phillips on the design of piston type accumulators in the February issue. We are unable to understand how the grease in the piston, sketch 4, can be under a pressure in excess of that of the gas or oil. As we see it, all pressures are balanced and the "O" rings still have the same pressure on both sides. In fact, we cannot see how it is possible to put an excess pressure on the grease without having access to a lower pressure somewhere.

We would appreciate it very much if you would have Mr. Phillips explain his accumulator a little more in detail. It is possible that the accumulator works simply because the combination of grease and "O" rings make a good seal regardless of pressures.

G.F.W.

I appreciate your interest in my article and the good point that you have raised in your letter of February 14. To best answer your question properly I will outline three specific conditions that exist within a gas charged hydraulic accumulator.

Condition I—Gas charge but no oil in accumulator.
Condition II—Full oil charge in accumulator.
Condition III—Accumulator discharging oil charge.

Condition I. When the accumulator has a gas precharge but no oil in the oil side, the pressure of the grease on the seals is greater than the gas charge pressure, by the ratio of the larger over the smaller area of the secondary piston. See example below

Condition II. When the accumulator has a full oil charge and the unit is in a state of equilibrium, the oil, gas and the grease seal pressures are the same. See example below.

Condition III. When the accumulator is discharging oil, the oil pressure is less than the gas pressure and the grease seal pressure is greater than either the oil or the gas pressure. See example below.

In effect, the grease seal pressure on the two seals is always equal to or greater than the gas or oil pressures and therefore gives greater assur-

(Continued on page 14)

protection—
Hydraulic Equipment

The one fluid that:

1. Prevents Rusting

With a new combination of inhibitors, the result of eight years' continuous research and operating tests. The chart on opposite page graphically illustrates the wide margin of superiority with which this new oil protects against rust.

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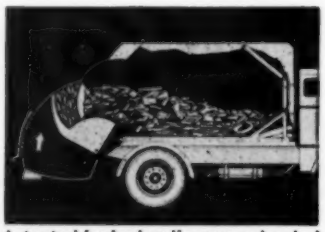
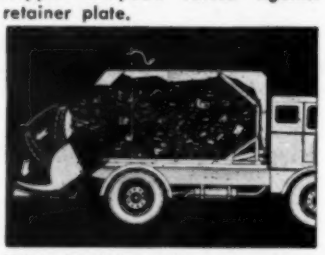
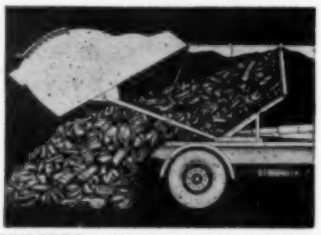
BUILD MORE PROFITABLE LABOR-SAVING INTO YOUR EQUIPMENT WITH *HYDRECO* CONTROLS


Actuated by hydraulic power, loaded hopper compacts refuse against retainer plate.


When loaded, retainer plate comes down flush against compressor plate.


HYDRECO cylinder operates unfolding bulkhead built in three sections.

All sections of bulkhead reach an angle of 45° with tailgate completely raised—assuring rapid, complete unloading.

HYDRAULIC EQUIPMENT COMPANY
1104 EAST 222nd STREET • CLEVELAND 17, OHIO

Letters to the Editor

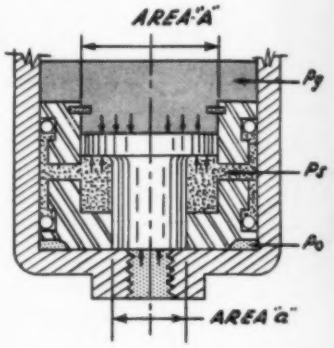
(Continued from page 10)

ance against (a) "rocking" of the seals back and forth in their grooves during the up and down movements of the piston. This provides longer life for the seals; (b) seepage or leakage of gas past the seals into the oil side or oil into the gas side is reduced, if not entirely prevented. The recommended constructuion, in addition, provides smoother piston movement with the better lubrication of the seals.

Example: Assume

Area "A" = 2 sq in,
Area "a" = 1 sq in
Gas Precharge Pressure =500 psi
Max. Oil and Gas Pressures =1000 psi

P_g = *Gas Pressure*
P_s = *Seal Pressure*
P_o = *Oil Pressure*



Condition I:

Summation of all forces;
$AP_g - aP_o - P_s(A-a) = 0$
$(2\times500) - (1\times0) - P_s(2-1) = 0$
$P_s = 1000$ *psi*
($P_g = 500$ *psi*; $P_o =$ *zero*)

Condition II:

$P_g = P_o = 1000$ *psi;*
summation of forces
$= AP_g - aP_o - P_s(A-a) = 0$
$= (2\times1000) - (1\times1000) - P_s(2-1) = 0$
$P_s = 1000$ *psi* $= P_g = P_o$

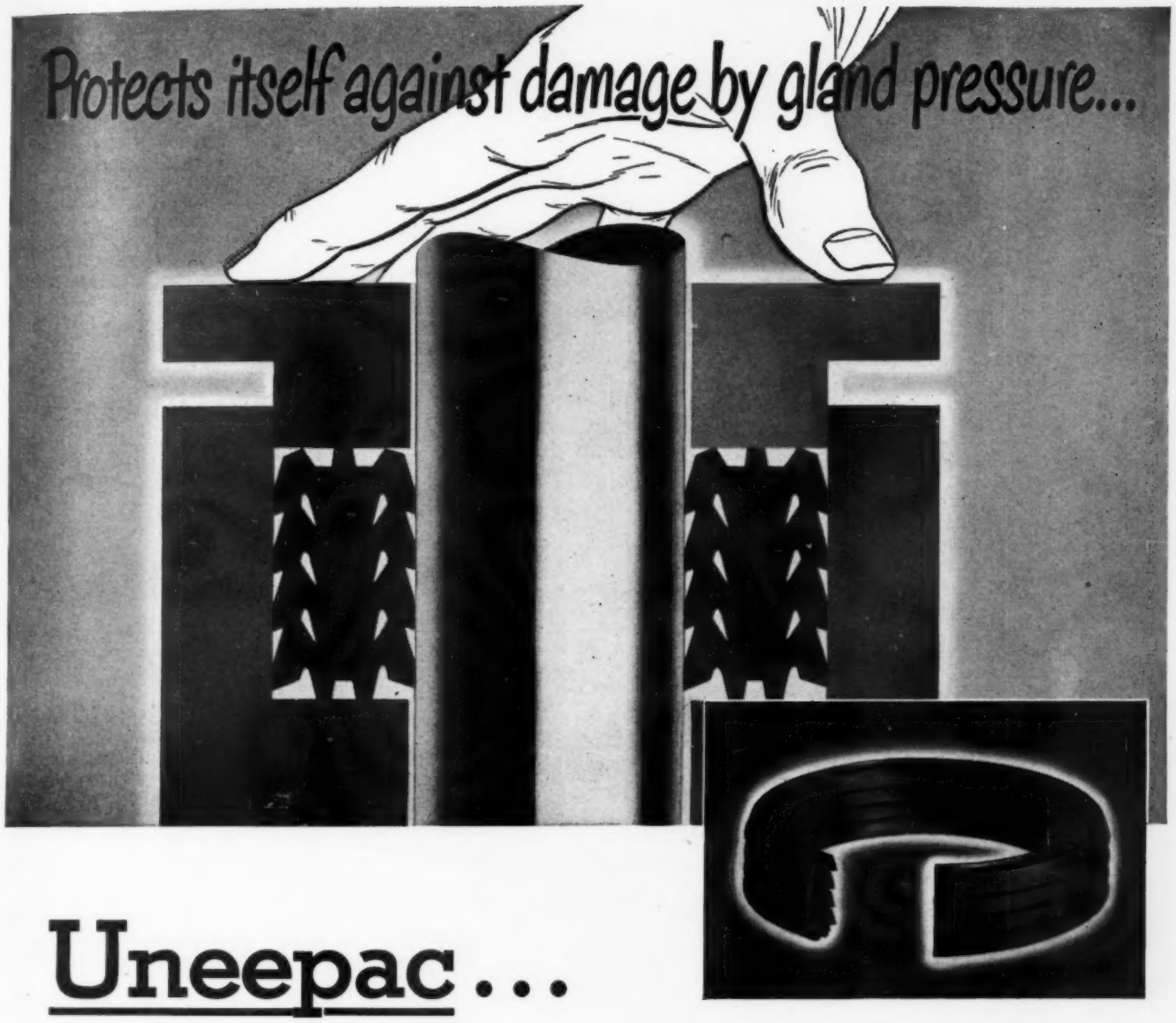
Condition III:

When discharging oil from accumulator—oil pressure is less than gas pressure (as gas pressure is motivating force), therefore $P_g = P_o + \Delta P$, *or assuming* P_s *as 1000 psi and oil is starting to be discharged—*$P_o = (1000\text{ psi} - \Delta P)$,
summation of all forces;
$AP_g - aP_o - P_s(A-a) = 0$
substituting,
$AP_g - a(1000 - \Delta P) - P_s(A-a) = 0$
$(2\times1000) - 1(1000 - \Delta P) - P_s(2-1) = 0$
$2000 - 1000 + \Delta P = P_s$
$= 1000 + \Delta P$

P_g *is greater than* P_o *by* ΔP *and* P_s *is greater than* P_g *by* ΔP.

M.J.P.

(Continued on page 18)



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the new Johns-Manville automatic ring packing

HERE AT LAST is an automatic ring packing that's designed to eliminate one of the most common causes of packing failures!

A glance at the cross section above will show you why. Note the projecting portions of the center section of each Uneepac ring. These projecting "legs" provide an effective safeguard against damage by excessive gland pressure. Header and follower rings are therefore seldom required.

Another important advantage is also provided by this unique design. Each Uneepac ring centers itself on the preceding ring so that the entire set is aligned vertically and nested perfectly. This feature practically insures trouble-free installation.

If you are looking for an automatic ring packing that seals effectively in a minimum of space . . . operates with a minimum of friction . . . and is instantly responsive to fluid pressure changes . . . you will want all the facts about Uneepac. Bulletin PK-58A is free for the asking. Just address Johns-Manville, Box 290, New York 16, New York.

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Johns-Manville PACKINGS & GASKETS

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TUBE FITTING

- 37° flare angle
- Dryseal pipe threads
- has *actually* passed rigid AN-F-47 performance test as required by J. I. C. standards. *Certified laboratory test report* available.

MADE BY THE WORLD'S LARGEST MANUFACTURER OF LEAKPROOF TUBE FITTINGS.

- precision-made to be *leakproof* under even the severest operating conditions.
- holds *leakproof* beyond tube bursting pressures.
- 3-piece design—remains *leakproof* after repeated reassembly.
- accommodates full range of standard tube wall thicknesses.
- made in steel, stainless steel, also aluminum alloy.
- shape bodies machined from forgings, other parts from bar stock.
- stocked by distributors across the nation.
- write for Parker "Industry Standard" Tube Fittings Catalog 203.

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The PARKER Appliance Company
Cleveland 12, Ohio

Please send my free copy of Tube Fittings Catalog 203

Name_____

Company_____

Address_____

City_____ State_____

Letters to the Editor

(Continued from page 14)

Several months ago I read an article in your magazine which described a double acting cylinder of special design. This cylinder did not have a through rod, yet it could develop equal forces on in and out movements, or could be designed to give differential ratios of forces. I cannot locate my copy of this issue and would appreciate your sending a reprint or tear sheet.

T.N.S.

You are to be congratulated on your memory. The article you refer to was "A Telescopic Cylinder" which was published in the June, 1948 issue of APPLIED HYDRAULICS. We are sending a set of tear sheets of this article to you.

We are trying to locate a manufacturer who can supply a miniature size hydraulic cylinder with the following specifications: bore up to 2 in; stroke 1 in maximum; operating pressure 350-400 psi; single acting, spring return. For our contemplated use the overall length must be kept to a minimum.

B.A.H.

This is not a standard item for manufacturers of hydraulic cylinders. We suggest you call in your local representative who probably can make some suggestion after he understands your application.

I would appreciate learning the address of the Joint Industry Conference and any other technical associations that publish information on the design of pneumatic and hydraulic equipment.

E.R.

The secretary of the Joint Industry Conference is R. M. Mitchell, Product Engineering Section, General Motors Corp., 15-228 General Motors Bldg., Detroit 2, Mich. The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y., can give lists of publications of their Hydraulic Division. The chief source of pneumatic design information is Compressed Air and Gas Institute; the address of their Committee on Engineering Education is 1404 Terminal Tower, Cleveland 13, Ohio.

RACINE HYDRAULIC PUMPS

Simplify your Circuit

Less valves and controls in a circuit provide easier installation and lower initial costs.

RACINE "Variable Volume" Pumps eliminate relief valves and extra piping. They reduce horsepower requirements and avoid excessive heat losses. Over-all cost of motor and reservoir is usually reduced. Efficiency is high because RACINE Pumps "put all of the oil to work."

A wide range of governor controls provide pumping action at the proper pressure and volume to handle any given job most effectively. These interchangeable governors are an exclusive RACINE feature.

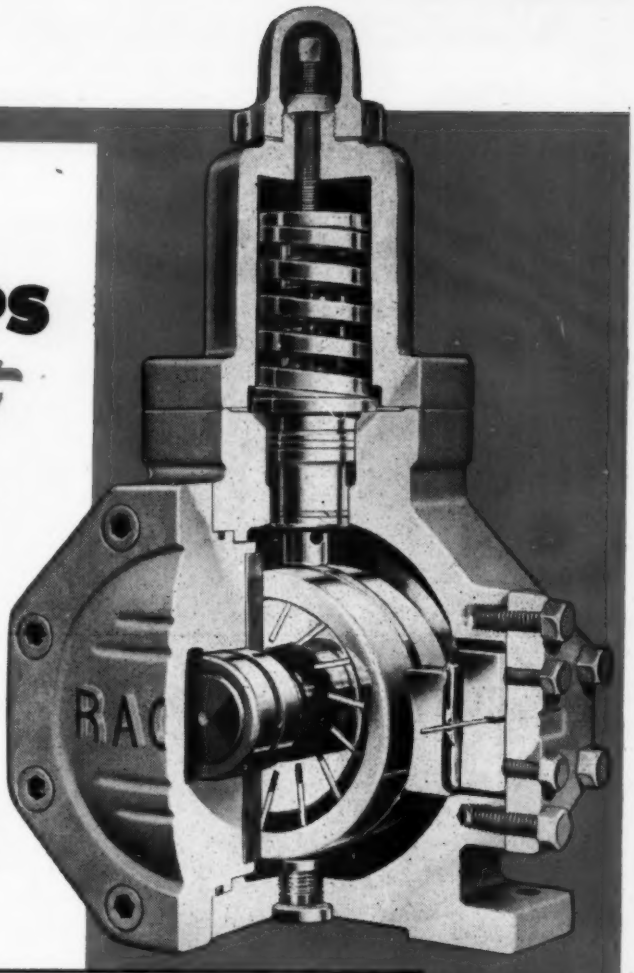
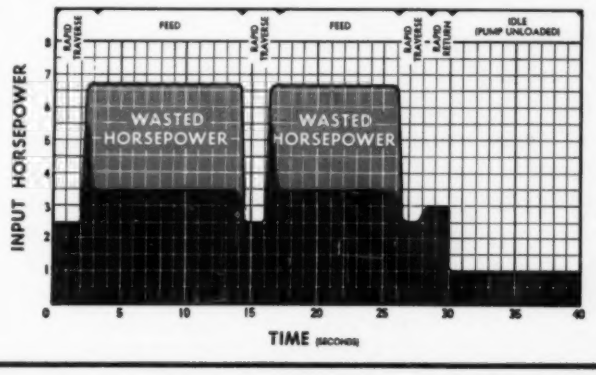


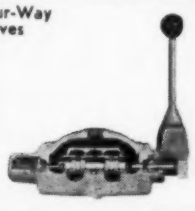
Chart below illustrates power consumption on a typical machine tool. Black area is power used with a No. 2 RACINE "Variable Volume" pump controlled by a pressure compensated feed valve. Area in red is power wasted by a constant volume pump, bypassing most of its volume through a relief valve during the feeding cycle.



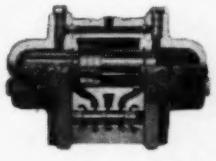
Write for new 3-color Catalog P-10-D covering RACINE's complete line of "Variable Volume" Pumps, Valves and Pressure Boosters.

OTHER RACINE HYDRAULIC PRODUCTS

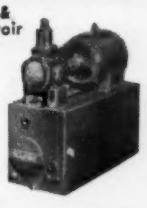
Four-Way Valves



Pressure Boosters



Pump & Reservoir Units



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A man-size mechanical grasshopper would have to reach top speed in six feet, soar 200 feet high, and land without shock 500 feet away. How would you make one today?

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LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

ERMETO TUBE FITTINGS for high pressure use in ⅛ to 2 in o.d. are described in Weatherhead Catalog E 1457.

Circle 46 on Reader Service Card

RELIEF VALVE information is included in the Mechanical Data Book, prepared by The Fulflo Specialties Co., Inc.

Circle 50 on Reader Service Card

RECOMMENDATIONS for applying oil filters are described in literature available from The Hilliard Corporation.

Circle 49 on Reader Service Card

COMPACT BRONZE FLUID HANDLING PUMPS giving large deliveries where space is at a premium are detailed in literature offered by Oberdorfer Foundries, Inc., Industrial Pump Division.

Circle 16 on Reader Service Card

HAND OPERATED AIR VALVES, for a wide number of 3-and 4-way applicatioins, are detailed in bulletins offered by C. B. Hunt & Son, Inc.

Circle 51 on Reader Service Card

BULLETIN 230, issued by Hannifin Corporation describes their electric valve controls for air installations.

Circle 48 on Reader Service Card

TWO COMPLETE CATALOGS are offered by Hanna Engineering Works giving specifications of pneumatic and hydraulic cylinders.

Circle 7 on Reader Service Card

AIRCRAFT APPLICATIONS of swivel joints are some of the many uses offered by these versatile fittings which are described in Chiksan Company's catalog 50 AH.

Circle 8 on Reader Service Card

FILTER PROBLEMS? Bendix-Skinner engineers will work with you to solve your specific oil filtration problem.

Circle 52 on Reader Service Card

(Concluded on page 69)

ANCHOR Adapter Unions

—Save You Assembly Time and Money

Anchor Ductile Sleeve Couplings assembled on two wire braid hose for high pressures.

Anchor Sleeveless Couplings assembled on either single wire braid hose or two rayon braid hose for medium or low pressures.

Anchor Clamp-type Couplings are ideal for field service use and emergency repairs. Easy to put on and take off—withstand high pressures.

Use Anchor Assembled Hose Units with the outstanding fittings shown above. You'll have less trouble in the shop on assembly — and less trouble in the field on the job.

Time is money And whenever you save time, you reduce costs.

That's why it pays to use Anchor Adapter Unions and Related Fittings. You see, they're designed especially to speed the attachment of Anchor hydraulic hose assemblies to equipment of all kinds.

In addition to cutting assembly costs, Anchor Adapter Unions and Fittings have these important advantages:

- They provide a leakproof ground-joint connection.
- They are small in size, require little space, and provide a neat appearance.
- You can connect and disconnect them many times without destroying the seal.
- Made from solid steel bar stock and plated to prevent rust, they stand up under the toughest service conditions.
- Their use lets you eliminate one or more pipe-thread joints—gives you a better piping job.
- Assembly in confined spaces is quicker and easier.

The Anchor line of Adapter Unions and Related Fittings is the most complete line available. Save yourself time and money—select those that fill your specific needs.

Send for complete information on Anchor Adapter Unions and Fittings

CLIP COUPON TO LETTERHEAD AND MAIL TODAY!

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I like the dependability, the safety, and the time-and-money saving features of Anchor Adapter Unions and Fittings. Please send me a catalog.

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M. I. T. Offers Summer Short Course "Fundamentals of Hydraulic Power Control"

THE MASSACHUSETTS INSTITUTE of Technology will offer a special short course in the Fundamentals of Hydraulic Power Control, July 9-20. This course, designed especially for the practicing engineer, is open for those with no previous formal training in the hydraulic field. However, a general background in mechanical engineering will be required of applicants. This is the first time such a short course has been available to engineers in industry.

The sessions for the two weeks will place emphasis on recent developments which permit the attainment of previously unrealized accuracies and speeds of response. System synthesis and design will be studied, including such high performance closed-loop applications as hydraulic servomechanisms, governors and precision machine tool control systems. Hydraulic system components, including pumps, motors, line components and flow control valves will be discussed.

Afternoon Laboratory Sessions

Though the primary emphasis will be on hydraulic elements, electrical and mechanical analogies will be used freely and associated non-hydraulic components will be discussed briefly.

Morning lectures will be supplemented by laboratory and demonstration work in the afternoons in the Institute's well equipped laboratories.

The sessions will be under the direction of Professor John A. Hrones, who is in charge of the M. I. T. Dynamic Analysis and Control Laboratory.

Because the enrollment will be limited and the fact that the course will not be repeated this year, it is advisable that applications be made promptly. An announcement, giving details of tuition, living accommodations, library and recreational facilities, is available from Professor Walter H. Gale, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

Two other short courses will also be offered in the field of mechanical engineering by the Summer Session. Lubrication Engineering and Metal Cutting.

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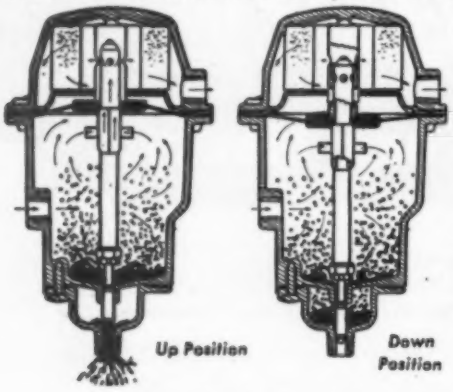

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Cross sectional view shows how the Wilkerson Valve controls moisture, oil, rust, dirt and other contaminants in air lines, tanks, after-coolers — anywhere compressed air is used.

The completely automatic operation, the one moving part coupled with strong construction of corrosive resistant materials assure long, trouble-free life. Double O-ring seal transmits full force of air without pressure surge—holds pressure drops to a minimum.

If you use compressed air ask for demonstration in your own plant—on any compressed air application you choose.

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12 pg. catalog illustrates complete Wilkerson line; gives operating and installation data and other important information on how to increase life and efficiency of your compressed air equipment. Write for it TODAY.

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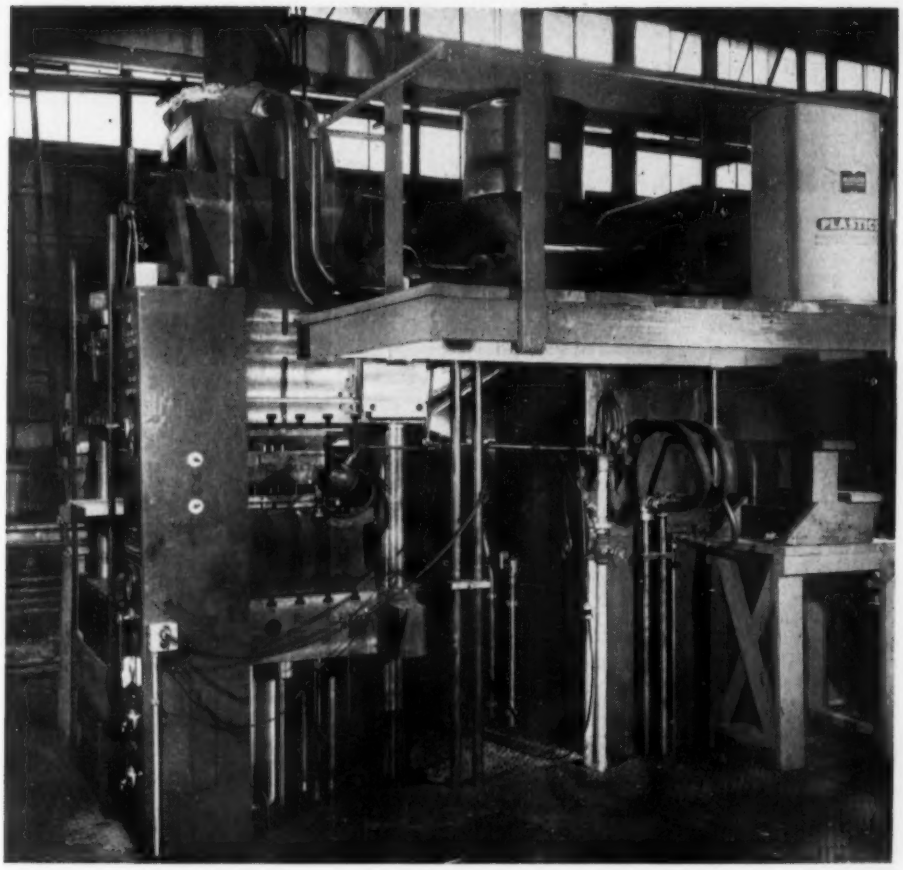


Fig. 1. A general view of the 64-ounce pre-plasticizing molding press at Chicago Molded Products Corporation. The extruder is overhead, the injection cylinder is in the head of the press and the main ram is shown extended holding the press closed.

Sizes Go Up — Pressures Go Down

JACKSON & CHURCH CO. OF SAGINAW, MICHIGAN is currently building the largest pre-plasticizing injection molding presses in the industry. These presses, embodying the Hendry pre-plasticizing process, actually are three-way molding presses: the pre-plasticizing is done in an electrically heated screw-type extruder at the top of the machine; the material is transferred by a vertically mounted top ram into the vertical injection area; the actual molding is done on horizontally mounted dies by the vertical closing of the main ram of the machine.

The advantages of a large, pre-plasticizing injection press—e. g., the press at Chicago Molded Products Corporation of Chicago has a capacity of 64 ounces of material per cycle—must be predominant to justify the relatively large capital investment. First, extra large pieces can be molded. The size of the press makes such pieces as washing machine agitators, automotive dash panels and television viewing panels practical to injection mold. Second, the relation of the size of the projected area to the holding pressure makes it possible to utilize a relatively low closing pressure (c. 2000 psi). This is very important in reducing or eliminating surface flow marks or flow marks through transparent material, e. g., pieces that are used as windows like television

Plastic parts are getting larger and heavier. This pre-plasticizing injection molding press used at the Chicago Molded Products Corporation, economically produces parts weighing up to 64 ounces. Oil closes the press, drives the extruder and powers the injection cylinder.

Fig. 2. The operator's position in front of the press. The lower platen has been lowered by the retraction of the main ram, opening the mold. The molded part, a television viewing panel, is on the unloading tray. Limit switches, controlling ram travel are at the left; the control panel with starting, jog and reset buttons, timers, heat switches, gauge and flow control valves are at the right.

viewing panels. The inherent advantages of horizontal flow in a mold are also utilized by the vertical injection design.

These advantages made this press a "natural" for the Chicago Molded Products Corporation of Chicago, one of the oldest and largest plastics molders. This company has pioneered in large unit injection moldings. Normally, very large presses would require high pressure ranges. With the Jackson & Church-Hendry press very large pieces could be molded at pressure ranges that would avoid the turbulence associated with high pressures and would permit flow rates that would hold to precision results essential for such pieces as television front or viewing panels.

A third requisite was that the cycle be short. As a single mold ties up the press, it is critical that the cycle be as short as possible.

The pre-plasticizing feature means that the injection pressure, the pressure to load the mold, can be kept low. This reduces turbulence of material flow, eliminating flow marks, critical on parts where such imperfections cannot be tolerated. Pre-plasticizing also helps reduce cooling time.

What is perhaps the largest package power hydraulic unit was designed and furnished by a leading manufacturer of hydraulic components. All of the pumps are mounted on the central reservoir and seven of the nine four-way valves in the circuit are mounted on a panel on the reservoir side away from the machine.

The piping was also a separate contract job, done by the J. N. Fauver Co., Inc., of Detroit.

An unusually wide range of soft annealed, seamless steel tubing was used to transmit power. Actually, seven sizes from ¼ in to 2 in tubing were used. To simplify both installation and maintenance, one type of three piece, all steel flared fittings was used throughout.

Hydraulic System

The hydraulic system is rather unusual because it is essentially a "package power unit" in design. The unit itself, in a space below the molding floor, is compact and is easy of access. All of the operating controls, starting, jog and reset buttons, timbers, heat controls, pressure gauge and flow control valves are mounted on a vertical panel at the right side of the press convenient for the operator.

The work cycle contains three major elements: (1) the operation of the extruder; (2) the opening and closing of the injection cylinder and (3) the opening and closing of the main ram. The extruder is driven by a fluid motor through a standard gear reduction unit; the operation of the injection and main ram cylinders is accomplished by selective use of three vane pumps—one double pump (A1, capacity 55 gpm and A2, capacity 27.5 gpm), a single pump AF (capacity 13.2 gpm)

(Continued on page 73)

You have probably needed a hook or tie rod in a hurry and resorted to a hammer and makeshift mandrel to punish the rod into shape. That tediously formed eye may have made you wonder how thousands of perfect hooks are made on production.

Form Hooks Fast

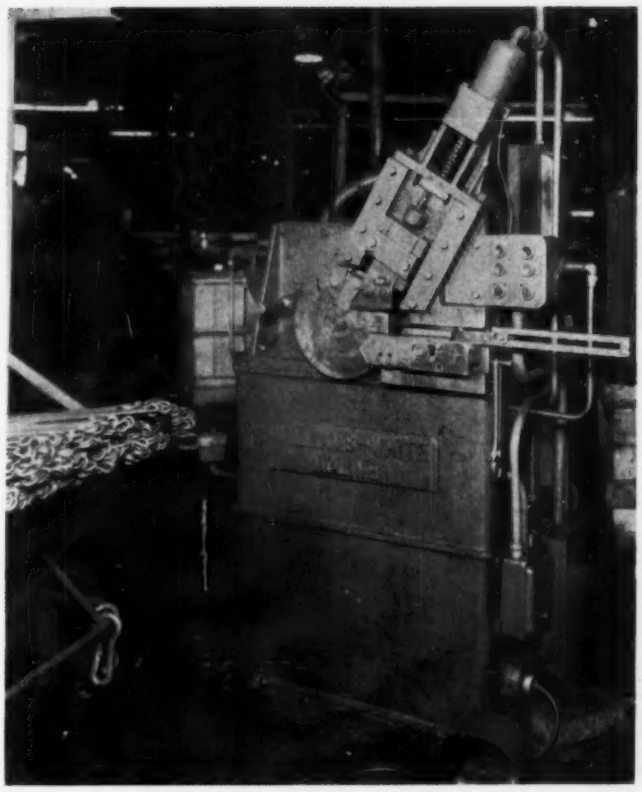
FORMING THE EYE ON THE END OF A ROD IS DONE quickly and uniformly on a machine which is built and designed by Williams-White & Co., Moline, Illinois.

One oil powered cylinder holds the rod while a second cylinder forms the eye by rotating the spindle through a rack and pinion.

Hydraulic power on this application provides a compact design which assures firm clamping and smooth, uniform bending.

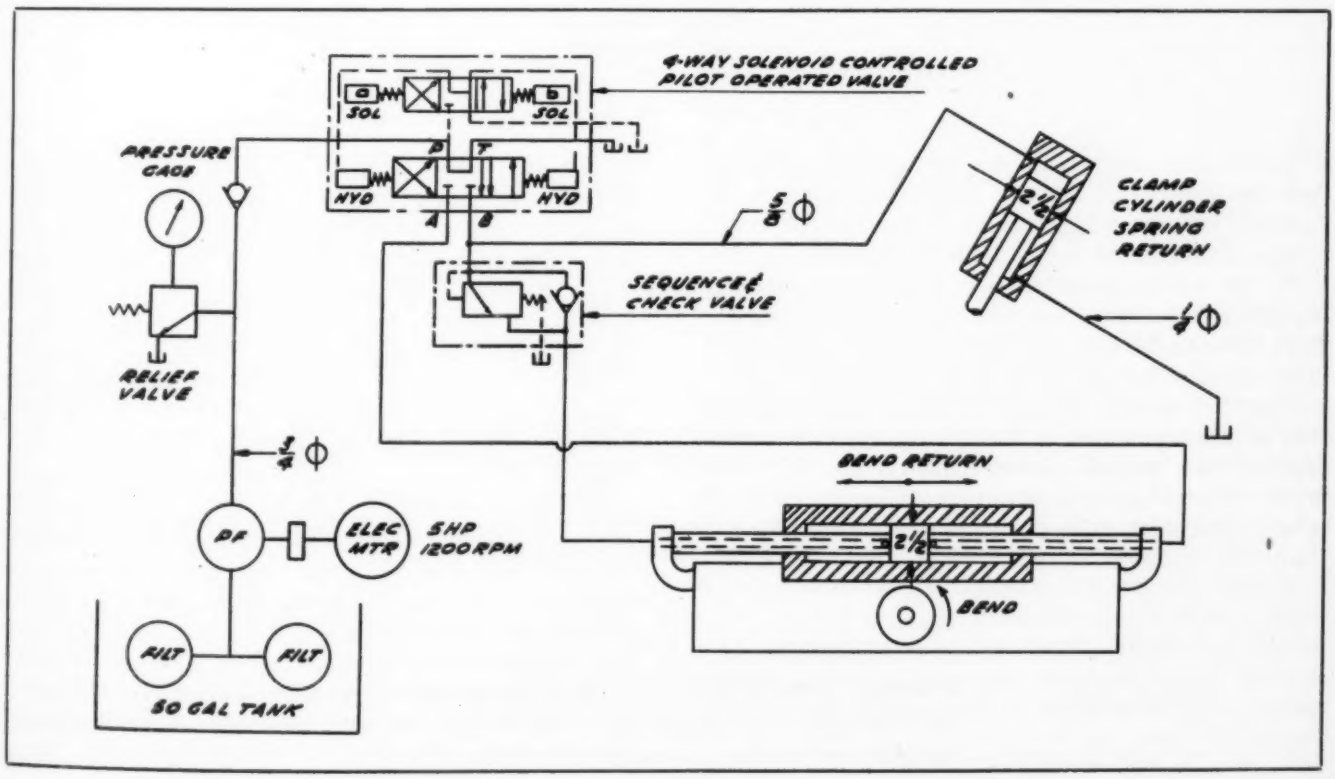
Mounted to the reservoir cover and built into the base of the machine are the electric drive motor and vane type, constant volume pump, which is capable of developing 800 psi. Control of the power cylinders is by a solenoid controlled, pilot operated, 4-way valve. In the neutral position

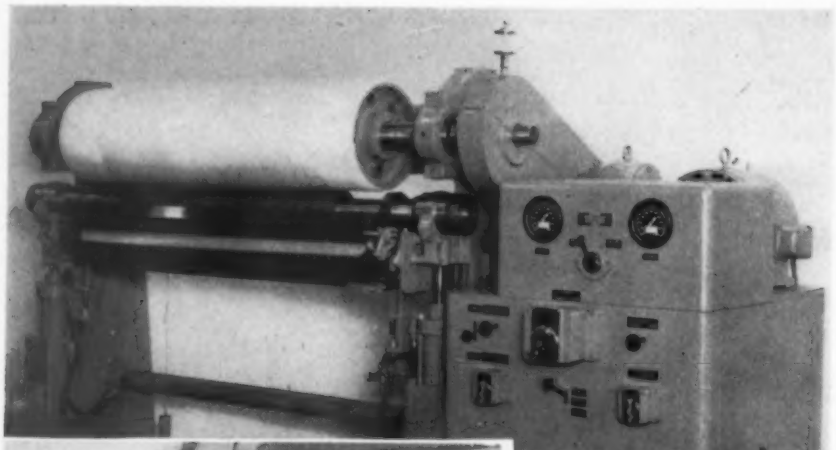
(Concluded on page 68)



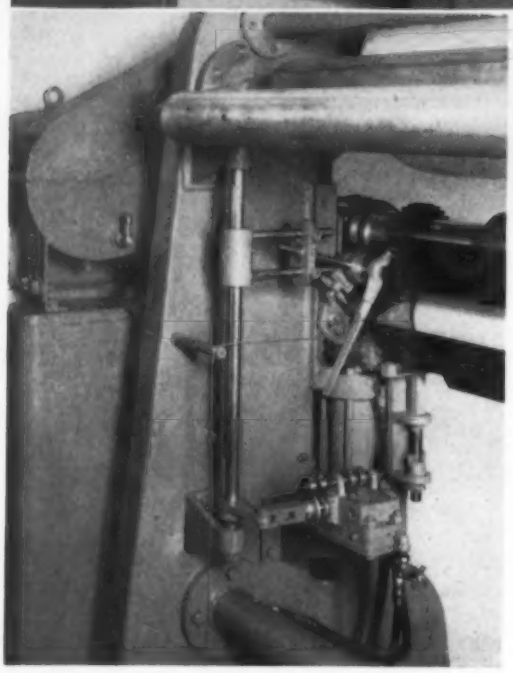
The inclined cylinder, shown at the top of the eye bender, clamps the rod and, then, a second cylinder moving a rack and pinion rotates the forming mandrel.

Use of a sequence valve assures tight clamping of the rod before the forming cylinder moves to perform the bending operation.





The cabinet at the side of the color printer houses the hydraulic components, electric drive motor and gear reducer. All levers and gages on the face of the panel provide efficient, simple control of nip pressure and roll speed.



Rear view shows flexible hose carrying oil power to the oscillator which moves the color doctor blade through a mechanical linkage.

Print on Film With Stepless Control

By E. W. CLEM
Vice President
Rice Barton Corporation
Worcester, Massachusetts

COMPLETE CONTROL OVER SPEED AND PRESSURE is the result of the hydraulic system designed into the Rice Barton Corp. single color, rotary, intaglio printer. Smooth, infinite control over the entire speed range has increased production while reducing the amount of attention from the operator. The exacting control has provided successful printing of vinyl film.

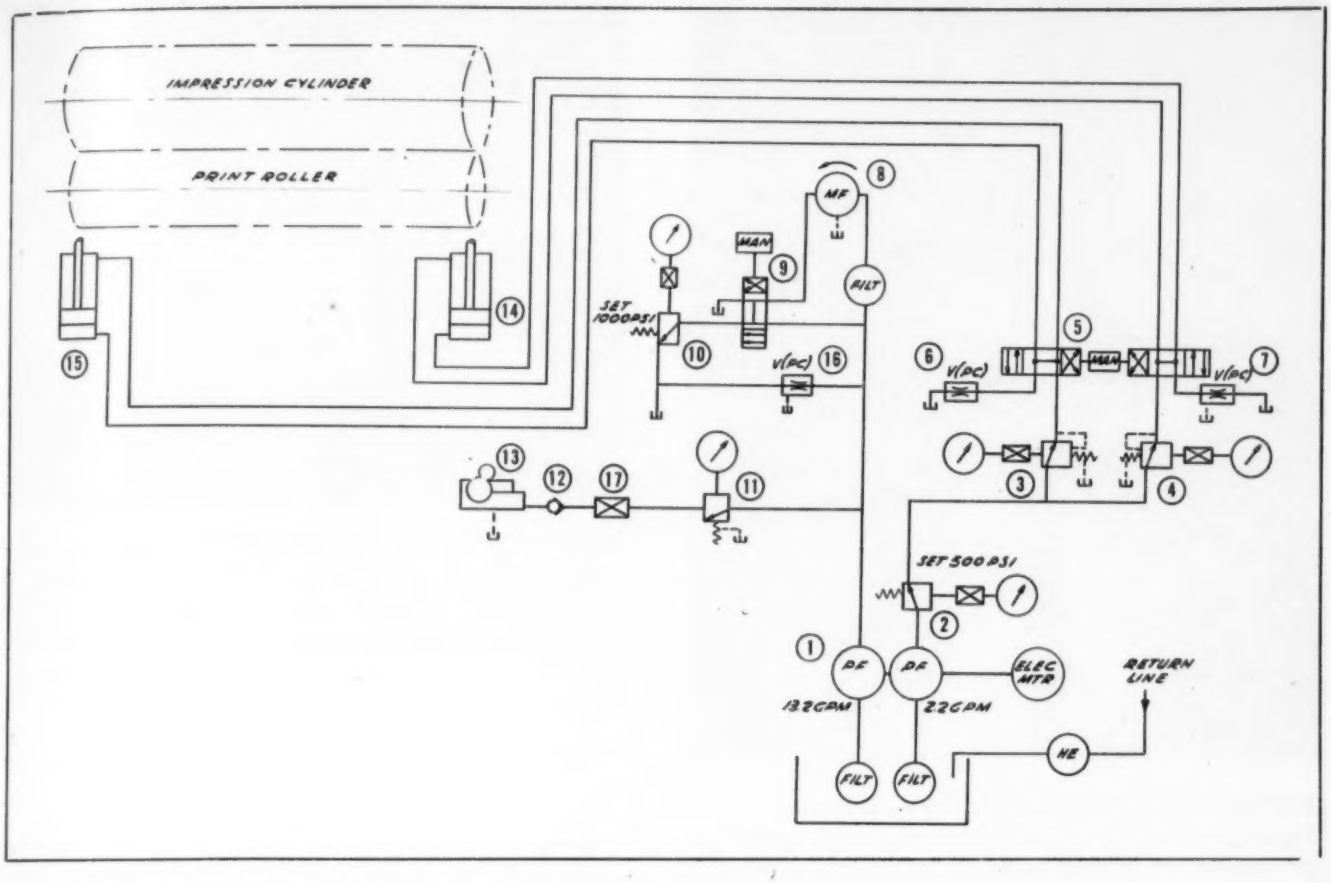
Mounted on the top, rear of the cabinet at the side of the machine, is the 10 hp electric motor driving the double pump through a "V" belt drive. The 40 gallon oil reservoir, complete with tube type cooler is in the base of the cabinet.

The shaft extension of the rubber covered impression cylinder, which is the upper large roller, is chain driven from a gear reduction unit. A piston type fluid motor provides the input power to the gear unit and makes possible stepless speed control of zero to maximum.

The engraved print roller which prints the pattern is raised and lowered from contact with the impression cylinder by the action of the two 4 inch stroke cylinders, 14 and 15, shown at the bearing ends.

On the front panel, flow control valves 6, 7 and 16 are mounted. Valve 16 is the large center flow

Printing is one of the many applications where oil power offers an economical, compact and easily operated system for very necessary control of material travel and pressure between rolls.



One side of the double pump supplies oil to the print roll cylinders, and the other side powers the impression cylinder drive motor and the color doctor oscillator.

control valve, and, referring to the circuit drawing, this valve controls the rotational speed ot the impression cylinder by limiting oil flow to the rotary motor. By means of flow control valves 6 and 7 both ends of the print roll raise at the same rate of speed regardless of pressure and each end of the engraved roller contacts the impression cylinder at the same time.

Once the flow control valve settings have been made they require little attention.

To start the electric motor drive, the operator flips the start lever on the left side of the panel. With directional valves 5 and 9 both in neutral, both sections of double pump 1 circulate oil through 5 and 9 and back to tank at negligible pressure.

Directional valve 5 is a rotary double deck 4-way valve, its control lever is seen between the gages on the panel. Moving the lever to the left directs pressure oil to move up the print roller cylinders 14 and 15. Pressure between the impression cylinder and the printing roller is controlled by means of the two pressure reducing valves 3 and 4. Each cylinder has independent pressure control to assure proper transfer of pattern to the material. The printing pressure may be increased or decreased with the machine in operation. Lowering of the print roll is quickly done by moving valve 5 to proper position.

Nip pressure gages permit the operator to duplicate results once the proper printing pressure is established. Two round knobs, seen on the panel, one on either side of the large flow control valve, provide for adjusting the pressure reducing valve settings by varying the valve spring tension. Relief valve 2 in the cylinder pressure circuit limits the pressure to 550 psi.

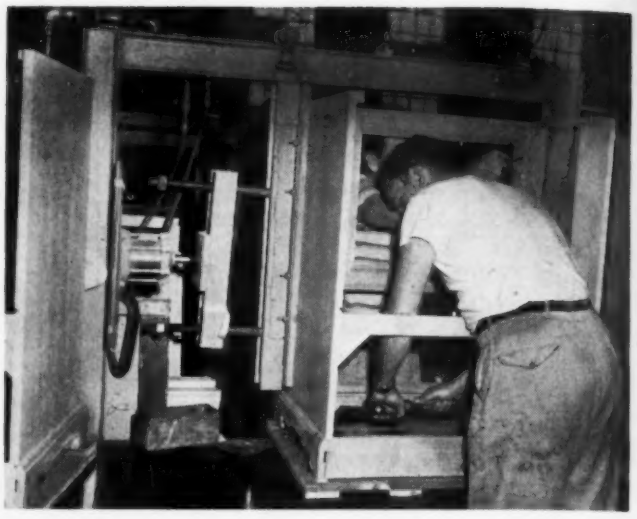
Braking System For Fluid Motor

The low pressure, 500 psi, low volume, 2.2 gpm, side of the double pump supplies oil to the roller raising cylinders, and the 1000 psi, 13.2 gpm side of the pump supplies the fluid motor. The color doctor is supplied from this same line but at reduced pressure and flow. Pressure is regulated by valve 11, and needle valve 17 governs the rate of oscillation.

Control of the fluid motor is obtained by moving the lever on the open center 4-way, 3 position valve 9. This lever is directly below the large flow control valve on the panel. In the neutral or stop position all ports are open to tank. In running position, pressure oil rotates the fluid motor

(Concluded on page 74)

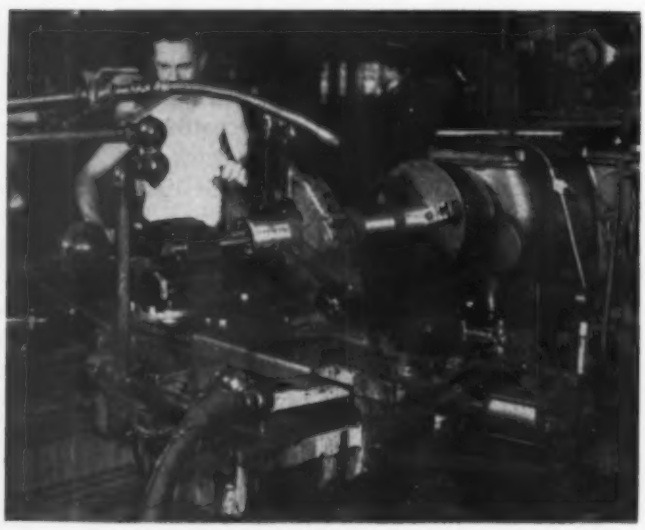
UNITED STATES RUBBER CO., Los Angeles, Calif. Curing bags are quickly yanked out of tires by the pull of this air cylinder, on a sling attached to the bag. The roller mounted carriage is retracted by the cylinder.



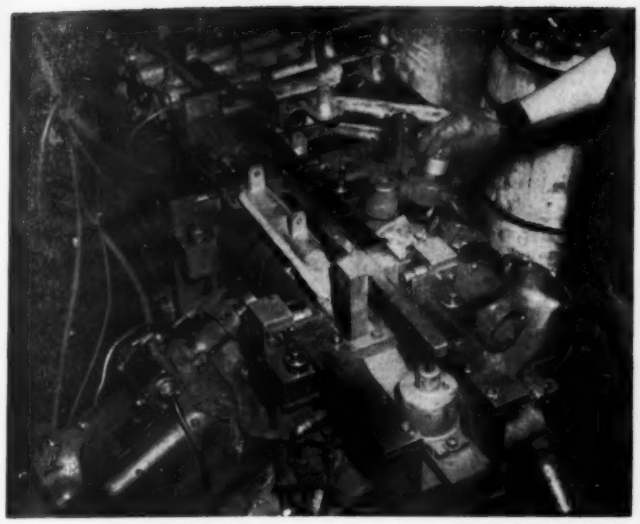
HOFFMAN RADIO CORPORATION, Los Angeles, Calif. Sides of cabinets are instantly lined up and held firmly in the positioning frame by pressure from the air cylinder. This smooth, straight pushing force replaced slow clamping methods.

Air Components Hel

MENASCO MANUFACTURING CO., Burbank, Calif. Engine lathes on production work are equipped with the profiler attachment shown here. Air cylinder at rear of lathe works on cross slide to hold the stylus against the profile blade. The profile template is at the front of lathe. A landing gear shaft, is being reamed.



THE FORD MOTOR COMPANY, River Rouge Plant. An air activated iron hand pulls a floorpan from a huge press. Even as the finished stamping is removed from the press, another steel blank is inserted, ready to be pressed. This is one of the many "automation" operations which offer safety, accuracy and speed.



ODIN STOVE CO., Erie, Pa. Oven burners are automatically drilled with the aid of air powered positioning in this jig. Working a three-way valve the operator moves the rear clamping cylinder and the vertically mounted front cylinder which moves the clamp lever.

McCULLOCH MOTORS CORP., Los Angeles, Calif. Air pistons instantly position and hold the work as it moves through the milling cutters. Air gives quick, positive load and unload, permitting one operator to easily tend two machines on this keyway milling operation.

Help You Meet Tight Production Schedules

Want to clamp parts quickly and rigidly?

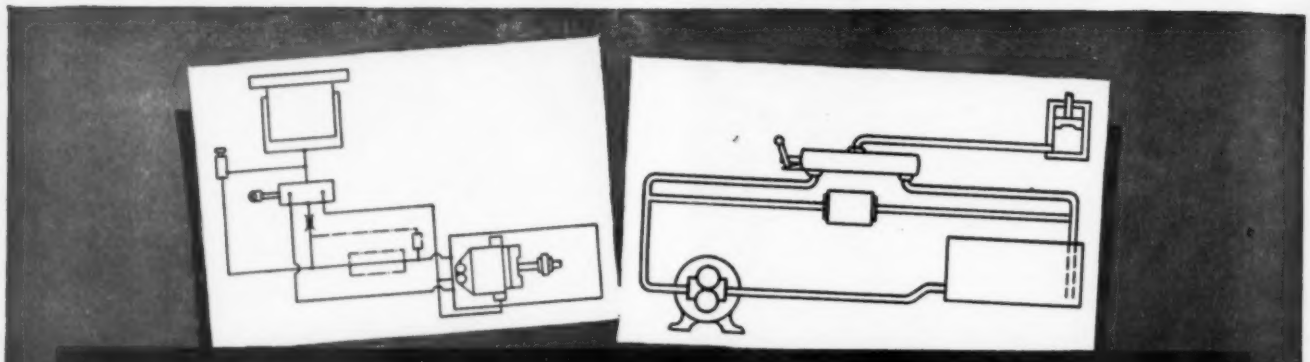
Want to reduce operator fatigue?

Want to position and assemble parts accurately and safely?

Here's how seven companies use simple quick acting air devices to accurately position and clamp parts for assembly, machining and forming.

FOOD MACHINERY CORPORATION, Riverside, Calif. Several methods of air clamping and positioning work are employed by the packing house equipment manufacturer. A typical example is the way truck handles are assembled by the squeezing action of the air cylinder on the assembly frame to join crosspieces and handles.

Photos Courtesy Compressed Air and Gas Institute



A Beginner's Course in Basic Hydraulics

Chapter VIII

HYDRAULIC PUMPS

Part 5

Vane Pumps

WHY USE ONE TYPE OF PUMP IN PREFERENCE TO another? This question is often asked when vane pumps are discussed, because the pressure and capacity characteristics of vane pumps are similar to gear units.

Vane pumps are commercially available to give pressures to 1500 psi, with several models developing up to 2000 psi. Capacities range from 0 to approximately 80 gpm.

Since gear pump characteristics fall within these same ranges other important design differences must be considered when making a pump selection.

Efficiency—of vane pumps is generally better than gear pumps and somewhat inferior to that of piston pumps.

Wear—Although the vanes can be readily replaced when worn, wear does present a problem which requires care and maintenance. If the vanes wear evenly to maintain a tight seal, this provides a certain amount of automatic takeup for wear.

Size—Particular gain can be made in the ratio of displacement to overall volume of the unit. This improved ratio is inherent in the design because the least volume is taken up by functions which have no part in the delivery process. This advantage results in a smaller pump for a given delivery when compared to other types.

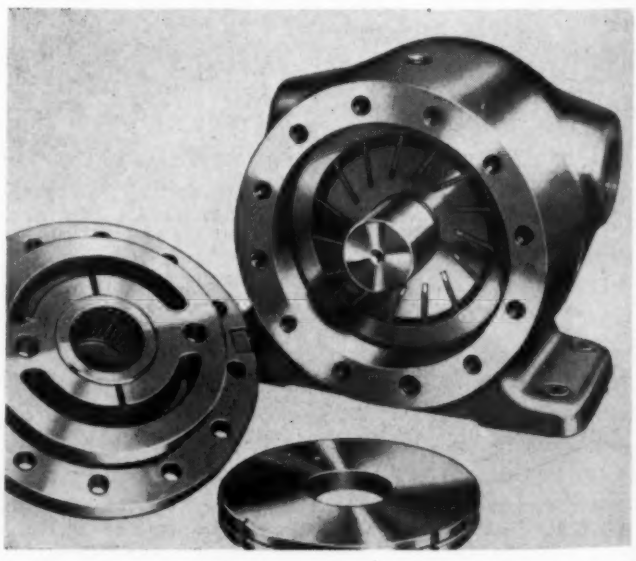


Fig. 11. Delivery can be increased or decreased on this Racine Model J, 1000 psi, pump by changing the eccentricity of rotor to pressure ring. The pressure ring is positioned by threaded studs.

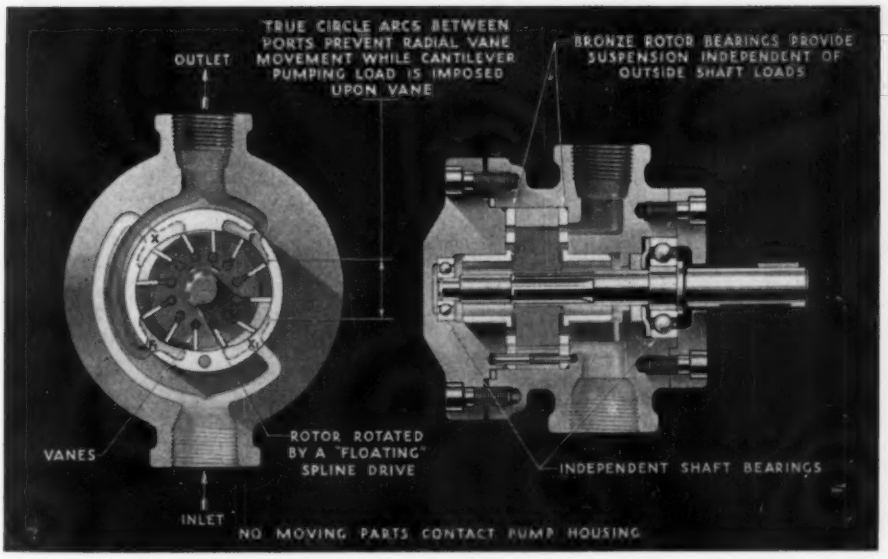

TRUE CIRCLE ARCS BETWEEN PORTS PREVENT RADIAL VANE MOVEMENT WHILE CANTILEVER PUMPING LOAD IS IMPOSED UPON VANE
OUTLET
BRONZE ROTOR BEARINGS PROVIDE SUSPENSION INDEPENDENT OF OUTSIDE SHAFT LOADS
VANES
ROTOR ROTATED BY A "FLOATING" SPLINE DRIVE
INDEPENDENT SHAFT BEARINGS
INLET
NO MOVING PARTS CONTACT PUMP HOUSING

Fig. 12. Construction and operation features of the Vickers balanced vane type pump. Pumping pressure which would otherwise produce bearing loads are cancelled out by equal and opposing pressure areas.

Cost—of vane pumps per unit displacement is greater than gear units and less than piston pumps.

Variable delivery—Here is a definite design advantage which vane type pumps have over gear pumps. They can be built to provide adjustable volume delivery and deliveries which can be changed automatically to meet varying load requirements.

Typical commercial designs are shown in accompanying illustrations. The basic vane pump consists of a rotor mounted in a housing, between closely fitted end plates. Slots cut in the rotor hold the vanes.

As the rotor revolves, the vanes which slide against a hardened insert move in and out of the slots. In the Racine design, Figures 11 and 13, the action of the blades is produced by mounting the rotor eccentrically in respect to the housing. Figure 12, the Vickers design uses a cam-like insert ring to cause movement of the vanes.

As the vanes rotate from the point of closest contact between rotor and housing, the resulting increased space fills with oil supplied through the suction valve slot (shown clearly in the exposed end housing Figure 11). After the point of maximum distance between rotor and housing has been passed, the spaces decrease and oil is discharged out the exhaust valve slot.

Centrifugal force holds the vanes against the housing insert ring as they follow the insert contour. However, to assure holding the vanes against the housing at all points, oil must be supplied to the bottom of the vane slots.

To supply this pressure oil, Racine pumps have milled slots in the side plates. These slots, seen in Figure 11, lead from the valve slots to the bearing race. In the Vickers design, the side plates are counterbored at the bottom of the vane slots. There is a continuous pressure against the bottoms of the vanes to force them against the insert and maintain a seal.

A third vane pump design, built by Dudco,

(Continued on page 70)

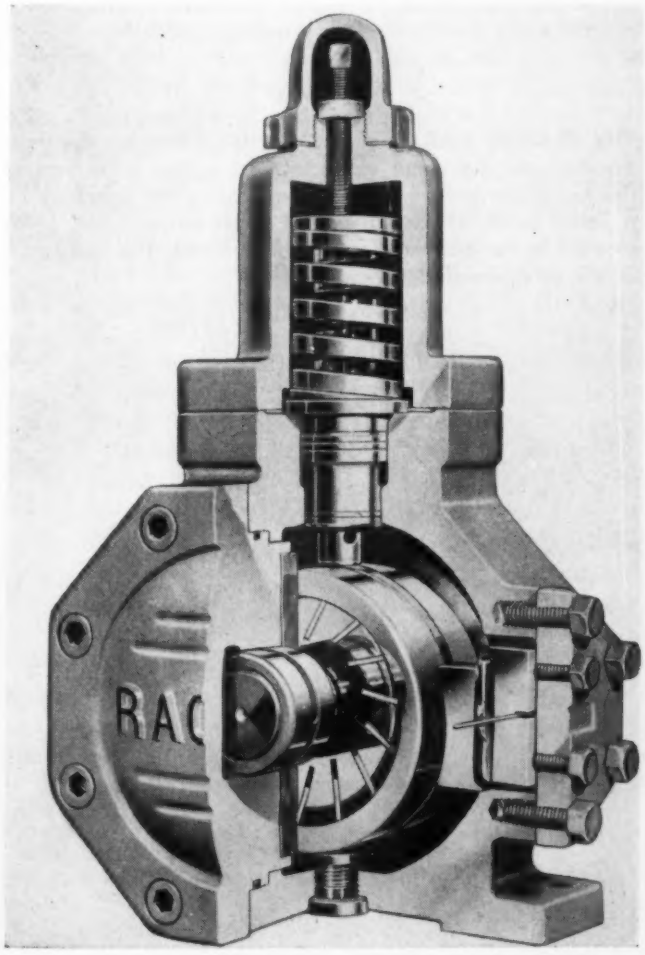


Fig. 13. A pressure compensated control on this Racine pump gives automatic variable volume control. High volume for rapid traverse applications and low volume for holding are obtained, providing a system with improved overall efficiency.

Hydraulic Steering of Rubber Tired Earthmoving Equipment

Part 2 discusses the full hydraulic system used on two and four wheel machines.

By G. J. STORATZ
Engineer-in-Charge
Road Machinery Division
The Heil Co.

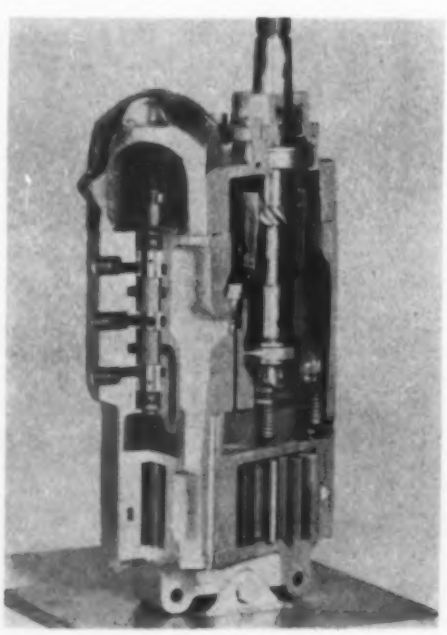
FULL HYDRAULIC STEERING WAS FIRST USED ON the four wheel type of prime mover where the steering was done with the two front wheels of the vehicle. The pictures illustrate this steering mechanism.

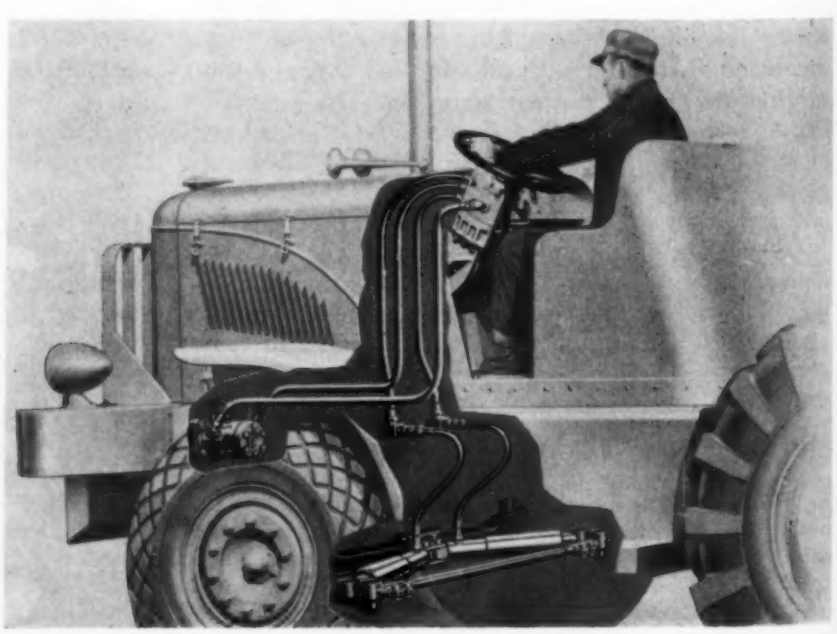
The construction of the steering head on the Heil full hydraulic system is such that it also acts as the reservoir for the oil and thereby eliminates the necessity of an auxiliary tank. The spool valve in the head is spring loaded, which keeps it in the neutral position when the vehicle is moving forward. The oil from the engine driven pump is circulated from the reservoir part of the steering head back into the center port of the head through the drilled holes in the spool valve, and back into the reservoir part of the head. This oil is circulated at very low pressure, and consequently no power loss is encountered.

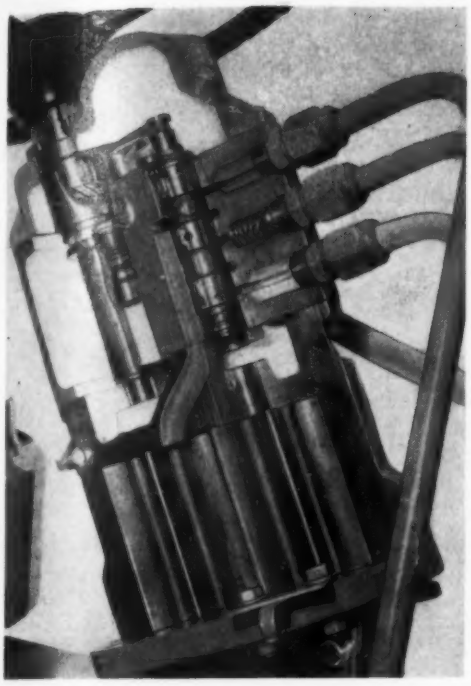
The steering cylinders on the axle are in a locked position and no road shock is transmitted through the mechanism to the driver. When the driver decides to turn to the right, he begins to turn the steering wheel and immediately the servo mechanism, operating a helical spiral cam mechanism, moves the plunger valve by positioning it in such a way that the oil coming from the pump into the center port is directed down into the metering gears. These metering gears are motorized and rotate at a predetermined speed, regulating the rate of steer. The oil then is discharged from the opposite end of the metering gears back through the head and through the top port going to the left steering cylinder. This steering cylinder has the fixed end connected to the center of the axle and the rod end to a special Pitman arm.

THE MAJOR PARTS of the steering head on the four wheeler are the spool valve located in the front part of the head, the servo mechanism operating the spool valve, a relief valve, check valve and a set of metering gears located in the bottom of the steering head. The head acts as the oil reservoir.

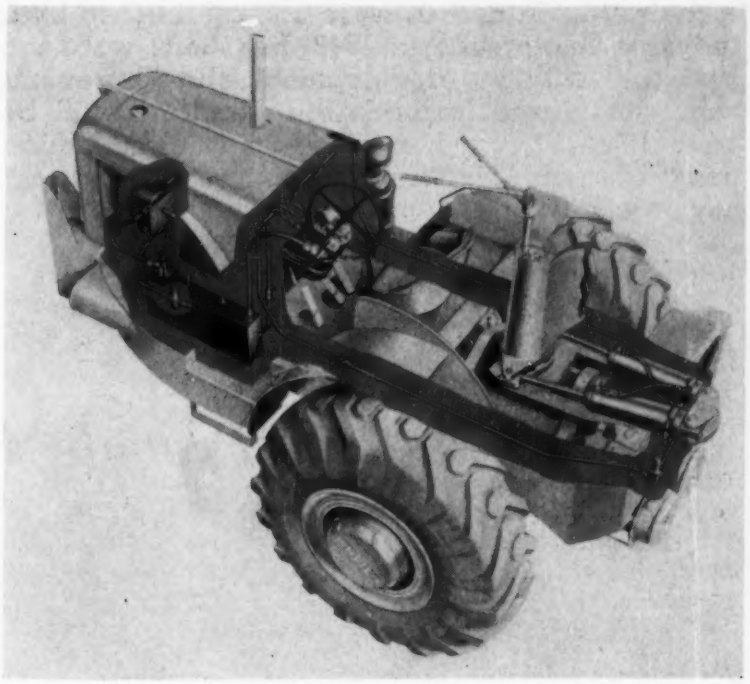
THE STEERING MECHANISM consists of the steering head mounted on the dash, engine driven hydraulic pump, and two steering cylinders connected to the front axle. The flow of oil to the cylinders is directed by the control head, and the relief valve in the unit is set for a maximum pressure of 800 psi.







FOR STEERING THE TWO WHEEL machine it was necessary to make the steering mechanism approximately five times larger in capacity than the head on the four wheeler. An auxiliary tank is used to allow for a larger volume of oil to keep the temperature of the oil down. The relief valve is mounted to the oil tank.



STEERING OF THE HEILINER is accomplished by the action of two interconnected double acting cylinders, acting on the fifth wheel spindle housing which is part of the trailing vehicle. The cylinders on the rear end are attached to the fifth wheel spindle mast assembly, which is a part of the tractor.

This cylinder, being single acting, begins to move, and the vehicle turns to the right. The Pitman arms are held together by a conventional tie rod so that when one cylinder is pressurized, steering movement is applied to the wheel. The tie rod operating the other arm causes the other wheel to follow and compresses the other cylinder. The oil from this cylinder is then forced through the hydraulic lines into the bottom inlet of the steering head and back into the reservoir chamber of the head.

An interesting safety feature in the design of this steering mechanism, is that it will function to steer the vehicle even if failure results to the engine driven pump. This is accomplished as follows:

> The check valve located centrally in the valve opens up and permits the oil from the reservoir of the head to be directed to the metering gears. These metering gears now become a hydraulic pump instead of a motor as in the previous operation, and they are actuated manually by the steering wheel. This oil then is directed through the same circuit to the steering cylinders as previously. The vehicle can be steered in this manner until repairs are made to the pump.

Steering the Two Wheel Heiliner

When the steering wheel is in the neutral position, the oil from the reservoir in the steering head returns to the oil reservoir which is attached to the frame. This oil then passes through the filter in the reservoir and then flows through the suction line to the suction side of the vane type pump. From the pump, the oil is forced through the pressure line through a relief valve and then through the center port of the valve and back into the oil reservoir. This circuit is continuous and operates at hardly any pressure when the vehicle is not being steered.

When the operator of the two wheel prime mover turns the steering wheel to the left, the steering valve and servo mechanism force the oil to feed through the metering gears and out of the top port into the hydraulic line. The operation of this steering head is the same as on the four wheel vehicle.

If the hydraulic system should fail completely, steering still can be controlled by operating an air valve located on the side of the steering head. This air valve controls the individual braking of the driving wheels, and this method of steer can be utilized until adequate repairs are made to the hydraulic system.

> Adapted from a paper presented at the Earth-moving Industry Conference, Central Illinois Section of the Society of Automotive Engineers, April, 1950.

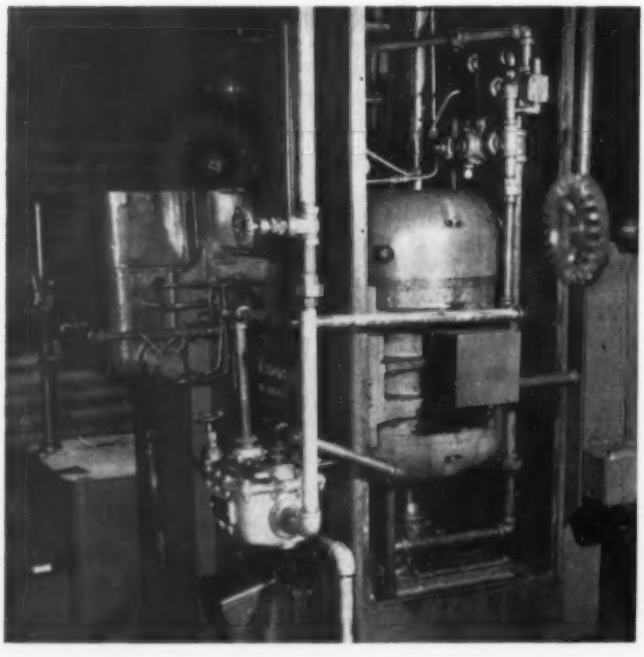
In the March 1951 issue of APPLIED HYDRAULICS, Hydraulic Steering with Mechanical Assist was discussed.

Hydraulic Standards were first established by a Joint Industry Conference in 1948. Revisions were made in 1949 and with the development and improvement of components and methods the standards will be kept up-to-date. Shown here are some of the advantages being gained by careful adherence to sound engineering practice.

J. I. C. Standards Provide Accessible Components

COST OF SERVICING AS WELL AS EASE OF OPERation of machine tools depend upon the convenient placement of hydraulic components.

Take a look at what was done to build convenience, serviceability and low operating cost into this 10 ton single ram broach.

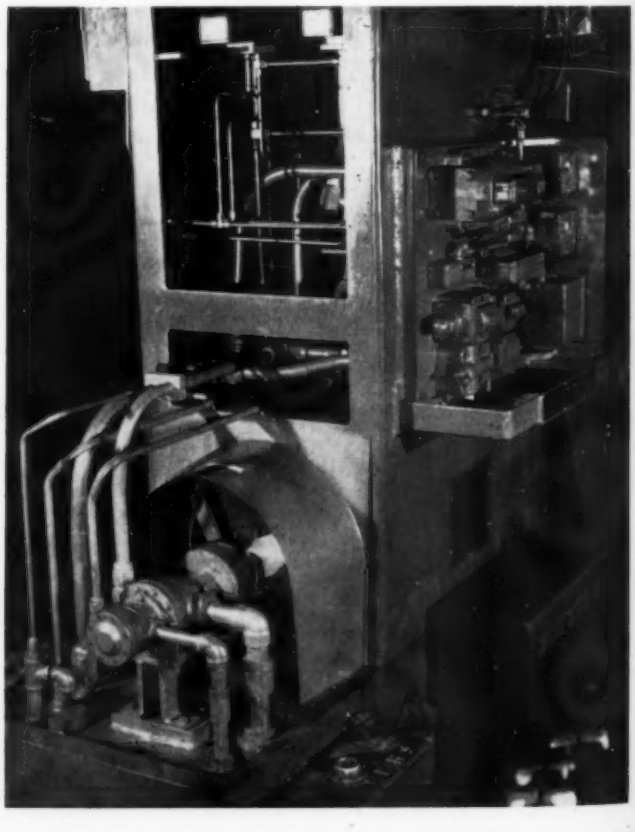


BEFORE STANDARDS This rear view of the broach does not show many valves because they are inaccessible even to the camera. The pump is mounted inside the reservoir on the underside of the cover. Servicing of the pump alone, requires the removal of so much piping and wiring that production down-time often exceeded two, 8 hour shifts. The array of piping and valves made necessary the use of an oil cooler to maintain efficient operating oil temperature.

AFTER STANDARDS Built to J.I.C. Standards, the machine now has sub-plate mounted hydraulic valves that are readily accessible in one central location. The piping is well supported and, of course, protective enclosures for the valve panel and piping, which were removed to take the picture, are easily mounted and provide for safe and clean operation.

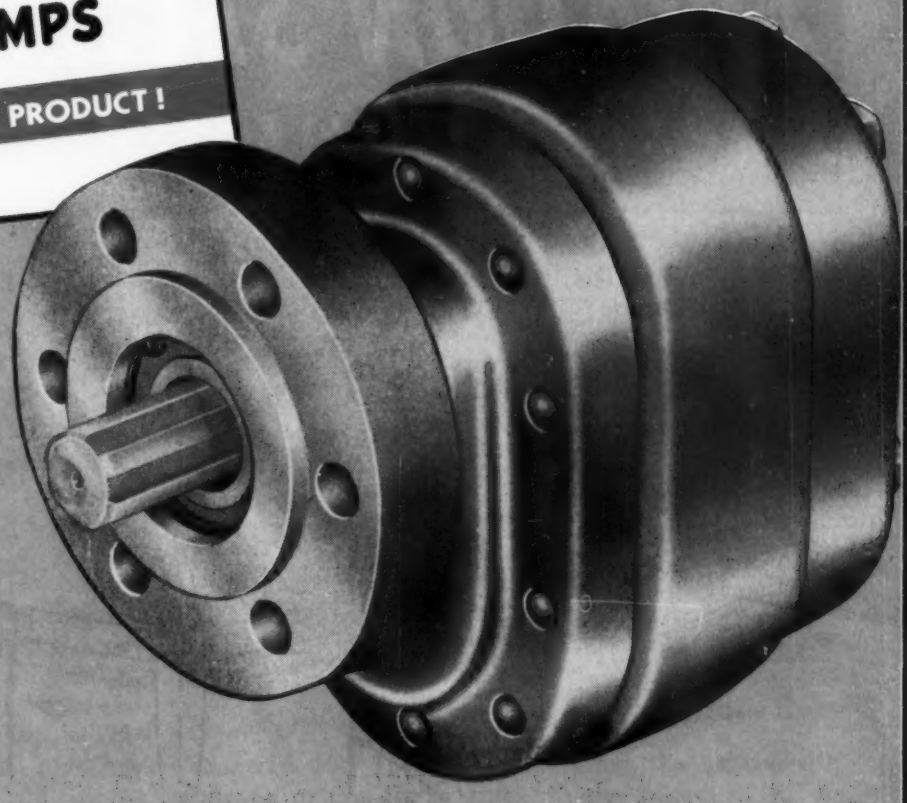
The pump and motor have now been mounted on top of the reservoir, making the changing of a malfunctioning pump a one man job. Note that the use of tubing and the careful consideration of component location greatly reduce the number of fittings, thereby, minimizing leakage and service problems.

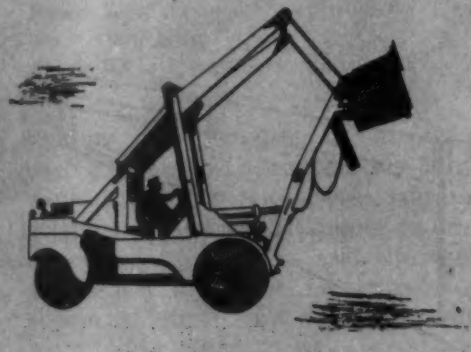
Photos Courtesy Ford Motor Co.



"COMMERCIAL" HYDRAULIC PUMPS

WILL HELP SELL YOUR PRODUCT!

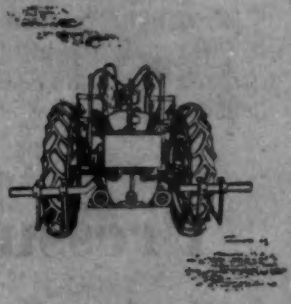


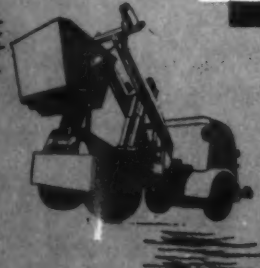


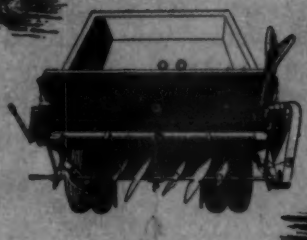
"Pressure Pocketed" thrust plates wear evenly and provide automatic balanced pressure at the gear face areas on both the high and low pressure sides of these new pumps. "Pressure Pocketing" is a "Commercial" exclusive — a new feature in gear pump design which has helped to increase the overall efficiency of the PD series pumps to over 90%.

"Positive Aligned" gears develop even, full strength loading of pump bearings. A new principle, which assures "Positive Alignment" in these pumps, permits satisfactory high speed operation at pressures up to 1500 p.s.i.

Perform Better - Last Longer

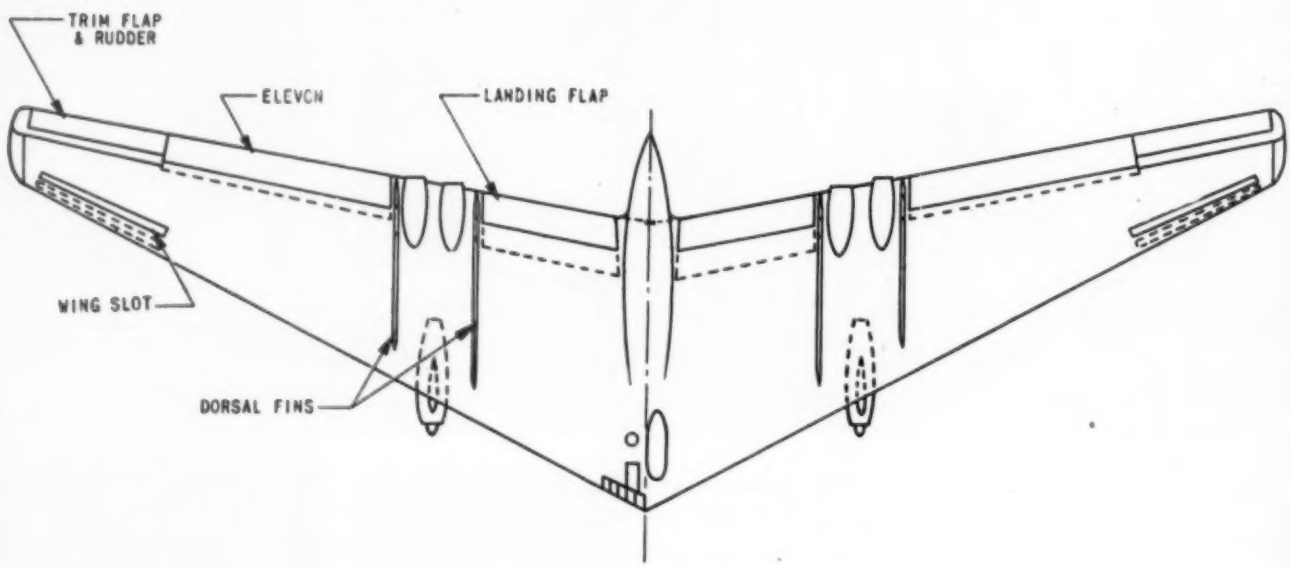






THE COMMERCIAL SHEARING AND STAMPING CO. YOUNGSTOWN 1, OHIO

RALPH E. MIDDLETON
Advisory Editor



Pressure Losses in the Flying Wing

By **WARDE L. PARKER**
Production Design Office
Northrop Aircraft Inc.

Fluid friction losses in long lines having many fittings greatly affect the efficiency of a hydraulic system. Mr. Parker tells how the losses on the Northrop Flying Wing using AN-0-366 fluid were determined.

DURING THE COURSE OF TESTING OF THE FLYING Wing Full Powered Surface Controls, data was taken of pressure losses in the entire hydraulic flight control system. The purpose of the test was to establish the accuracy of calculated values and to determine the proportion of fitting and bend losses to straight line loss. The outboard rudder system was tested for pressure loss from the point of pump output through the pressure line to the outboard rudder cylinder through a jumper at the point of the cylinder and back through the return line. The test stand which was a careful reproduction of the airplane's hydraulic system was modified only by the introduction of the jumper and the necessary test equipment. Pressure pick-up tees were installed in the pressure lines near the pumps, at the rudder cylinder jumper and in the return line im-

mediately ahead of the reservoir. Iron constantan thermocouples were installed a few inches downstream from all pressure pickup tees and a flowmeter was installed in the return line.

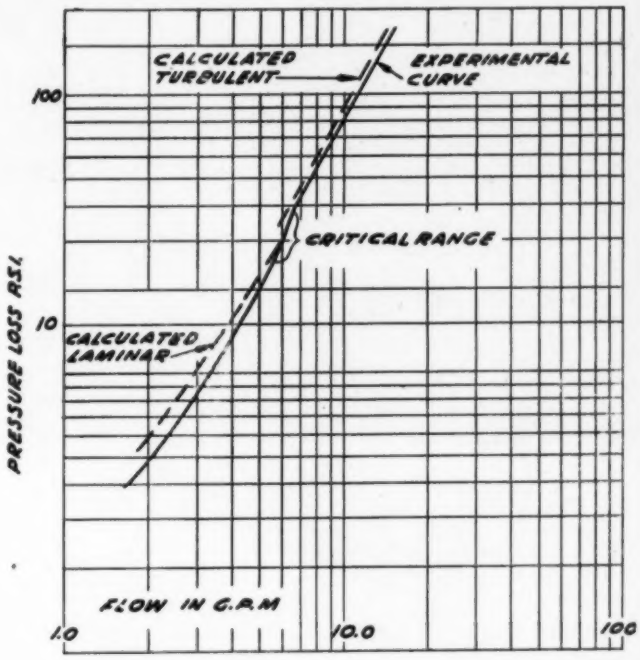
A record was made of all types and sizes of fittings, number, radius and degrees of smooth bends and length and diameter of all tubing. Following is a condensed list of tube fittings and bends in the entire system.

Item	Number	Length
.750 x .035 wall tubing		51 ft.
.625 x .035 wall tubing		65 ft.
AN815-10 Unions	7	
AN815-12 Unions	9	
AN926-12 Tees—Straight Flow	6	
AN919-20 Reducers	12	
Thermocouple Fittings	2	
Bends Less Than 90° Approx. 3" Radius	15	
Bends 90°—3" Approx. Radius	16	

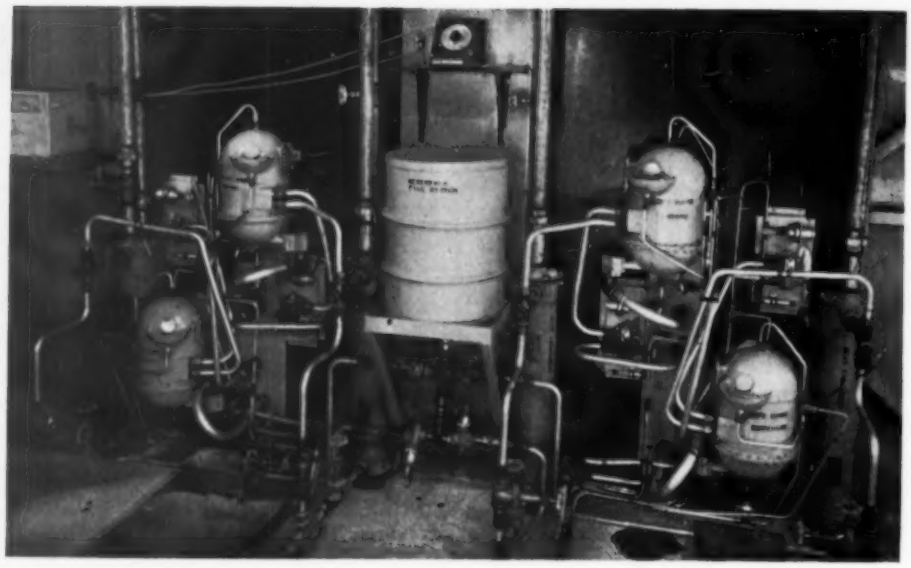
Flow was provided by means of two pumps each capable of approximately 8 gpm. During test runs, the pump speed was stabilized at the desired value and simultaneous readings were taken on all pressure gages and the thermocouple potentiometer. Particular care was taken to insure a stabilized flow condition while all readings were being taken.

Figure 1 shows in the solid line the experimental pressure loss through the entire system with flows varying from approximately one and one-half to fifteen gpm. The temperature of the AN-O-366 fluid for the majority of runs was approximately 100° F. It will be noted that a definite break in the curve exists in the region of 5.5 to 6.5 gpm. At these flow rates, the value of Reynolds number for the .625 dia. tubing is 2230 to 2640 and for the .750 dia. tubing, 1820 to 2150. Since these values of Reynolds Number fall into the critical range, it may be concluded that the

Fig. 1. Solid line shows the experimental pressure loss through the entire system with flow varying from ½ to 15 gpm. Fluid at 100° F.



Overall view of the Flying Wing test set-up for determining pressure losses. The split trailing edge rudder surfaces are seen in the upper right and left part of the stand, and the elevon surfaces in the lower left and right. Seats for pilot and co-pilot are in the foreground wtih instruments for recording test data. The hydraulic reservoir system is against the right wall.



Close-up of the hydraulic reservoir system for the Flight Controls Test Stand. Note the use of four heat exchangers to maintain the test temperature.

break in the experimental curve is due to transition from laminar to turbulent flow in the straight runs of hydraulic tubing.

Pressure Drop Calculations

Laminar pressure loss was determined by the following formula where Reynolds Number is less than 2200:

(1) $h = \frac{64}{N_r} \times \frac{L}{d} \times \frac{V^2}{2g}$ Where: h=head loss in feet of fluid
N_r=Reynolds Number
L=Length of tubing in feet
d=I.D. of tube in feet
V=Velocity of fluid in feet/sec.
g=Accel. of gravity
=32.2 feet/sec.^{2}

Turbulent pressure loss was determined by the Darcy Formula for values of Reynolds Number in excess of 2200.

(2) $h = \frac{.316}{\sqrt[4]{N_r}} \times \frac{L}{d} \times \frac{V^2}{2g}$ Where: All units are as expressed for laminar flow

Reynolds Number criterion for determination of type of flow.

(3) $N_r = \frac{Vd\rho}{\mu}$ Where: ρ=Density of AN-0-366 fluid in Slugs/ft.^{3}
μ=Viscosity of fluid in Slugs/ft. sec.

For ease of calculation formulas 1, 2 and 3 above were simplified by substitution of known values of density and viscosity of the fluid. Conversion factors were also introduced to make it possible to quickly obtain pressure loss in psi at any temperature by applying the factor to a relationship of flow in gallons per minute to inside diameter of tubing in inches. Formulas 1, 2 and 3 above thus become as follows:

Laminar Pressure Loss

(4) $P_f = \frac{F_L Q}{d^4}$ Where: F_L is a factor for laminar flow per Fig. 2 with AN-0-366 Fluid
Q=Flow in gpm
d=I.D. of tubing in inches
P_f=Pressure drop in psi per foot

Turbulent Flow Loss

(5) $P_f = \frac{F_T Q^{1.75}}{d^{4.75}}$ Where: F_T is factor for turbulent loss per Fig. 3 with AN-0-366 Fluid

Reynolds Number

(6) $N_r = \frac{F_R Q}{d}$ Where: F_R is factor for Reynolds Number taken from graph* with AN-0-366 Fluid
N_r=Reynolds Number

Pressure loss due to bends and abrupt expansion and contraction may be expressed in a similar form. All the factors shown are based on use of AN-O-366 Fluid.

Pressure Loss in a Smooth Bend

(7) $P_B = \frac{F_B Q^2}{d^4}$ Where: F_B is factor for bend loss per Fig. 4
P_B=Pressure loss in psi due to effect of bend. Does not include friction loss in the bend.

Abrupt Expansion Loss

(8) $P_E = \frac{F_E Q^2}{d_1^4}$ Where: F_E is factor for abrupt expansion loss taken from graph*
d_1=Small dia. in inches
P_E=Press. loss in psi due to effect of expansion

Abrupt Contraction Loss

(9) $P_c = \frac{F_c Q^2}{d_1^4}$ Where: F_c is factor for abrupt contraction loss taken from graph*
P_c=Pressure loss in psi due to effect of contraction

*These graphs are not shown here. Each shows curves similar to Figure 4, plotting a factor versus temperature.

The known viscosities and densities for given temperatures of the AN-O-366 have been used in simplifying the formulas given above.

The calculated pressure drop of all lines and fittings is plotted as the dotted line in Fig. 1. Friction loss in the hydraulic tubing was calculated for the entire run including the length of tubing in the bends. The loss due only to the bends was calculated by formula 7. The AN815 union has approximately 20 percent less area than the tubing and therefore, the pressure loss was calculated by formulas 8 and 9 for abrupt expansion and abrupt contraction to which was added the friction loss within the length of the fitting.

The flow in the straight runs of tubing is laminar when the Reynolds Number is less than 2200. Disturbances such as fittings and bends, however, produce turbulence which requires an increasing length of tubing to again attain laminar flow as the critical value is reached. For a .750 dia. X.035 wall tube, the length of straight line to return to laminar flow may be as great as 80 inches. For this reason, at flows below the critical value, an average of 50 percent of the tubing length was considered in turbulent flow because of disturbances and 50 percent as laminar. The calculated data shows a reasonable correlation with tested values in the laminar flow range. The discrepancy which exists at low flow is attributed to the increased ratio of instrument error to measured loss. Very good correlation of calculated and experimental values was obtained in the higher flow ranges.

Fittings and Bend Factor

Calculated values of pressure loss in the fittings and bends, as compared to the loss in the tubing showed that a close approximation of total loss in the system could be obtained by multiplying the tubing loss by 1.24. The fitting and bend factor for the sytem tested is therefore 24 percent. This factor has particular significance since in the early stages of design of a hydraulic system, it is possible to increase the tubing loss by this factor and obtain a close approximation to the total loss in the system. The fitting and bend factor was found to be the same for condition of laminar or turbulent flow within the range tested. Since turbulent pressure loss increases as the 1.75 power of the flow, whereas fitting and bend loss increases as the square of the flow, the factor to obtain total system loss increases as the flow increases. The hydraulic system tested employed less fittings in proportion to the length of tubing than would be expected in a hydraulic system of a smaller airplane. For this reason, the fitting and bend factor could be appreciably higher than 1.24 in such an installation.

(Concluded on next page)

Circle 36 on Reader Service Card

small

simple

LEAKPROOF

Westinghouse

"AP" TYPE

Pneumatic Check Valves

Disc-type construction permits flow of air in pipe lines in one direction only. Particularly applicable where there is a rapid, almost incessant, operation of the valve. Compact, simple, leakproof design; meets the rigid requirements of USAF for the 1500 psi class penumatic service.

PERFORMANCE

1. Proof Test—3750 psi
2. Burst Test—2250 psi
3. Max. Operating Pressure—1500 psi
4. Ambient Temperature Range——160 degrees F. to —65 degrees F.
5. Max. Leakage Rate— 80 cc/hr. Free Air
6. Tube Connections in accordance with AND 10050
7. Available in ¼" and ⅜" tube size

Westinghouse Air Brake Co.

AIRCRAFT DIVISION

WILMERDING, PA.

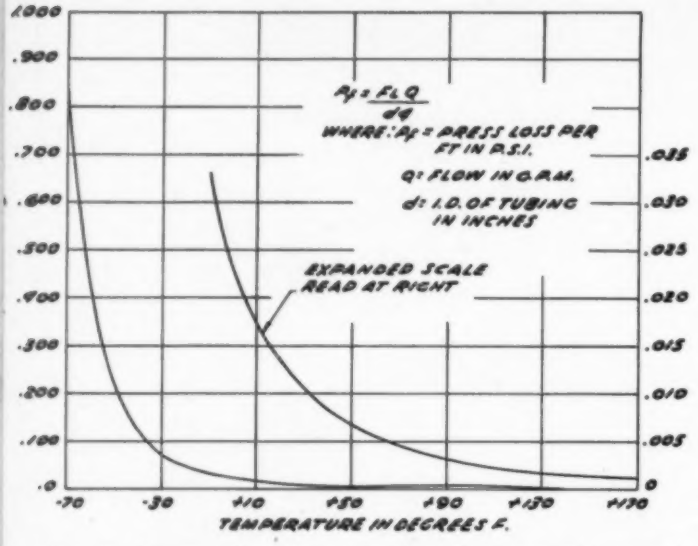


Fig. 2. Pressure loss factor—laminar flow, straight, smooth hydraulic tubing, AN-O-366 fluid.

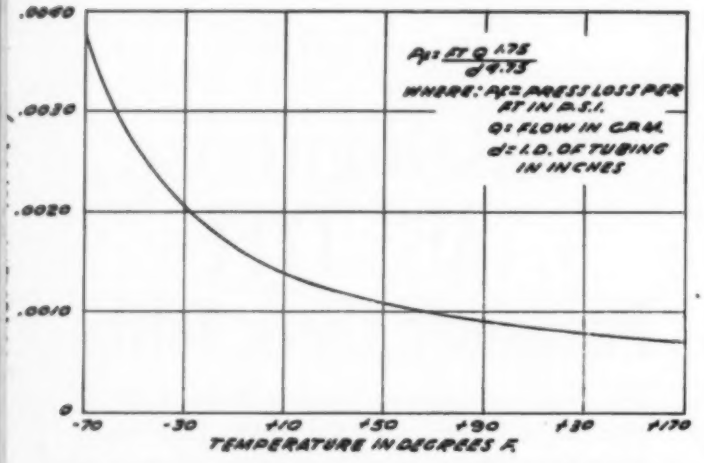


Fig. 3. Pressure loss factor—turbulent flow, straight, smooth hydraulic tubing, AN-O-366 fluid.

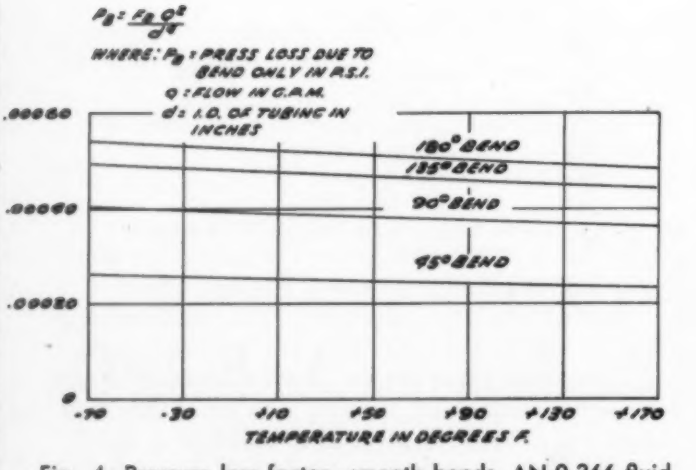


Fig. 4. Pressure loss factor—smooth bends, AN-0-366 fluid.

As mentioned previously, test data was taken at temperatures approximately 100°F. The fitting and bend factor of 1.24 would apply therefore, to a system operating at that temperature. At lower temperatures, the fitting and bend factor becomes smaller as the tubing laminar loss increases more rapidly than losses in the fittings and bends.

Effects of Temperature and Tubing Size

Figures 2 and 3 as plotted on regular coordinates show at a glance, the effect of pressure loss variation with temperature. The formulas for laminar and turbulent flow are expressed in a manner which makes very plain the effect of changing flow rate or tubing diameter. It will be noted that a small change in tubing diameter can have a large effect in reducing pressure loss; as for laminar flow, the loss is inversely proportional to the fourth power and for turbulent flow, the 4.75 power of the tubing inside diameter.

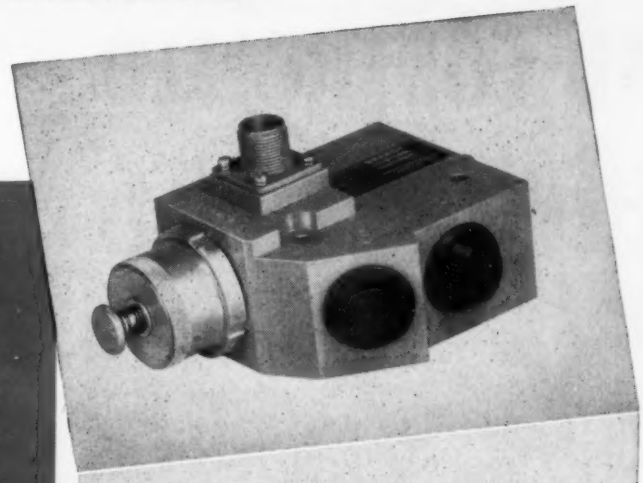
What is Hydraulic Friction?

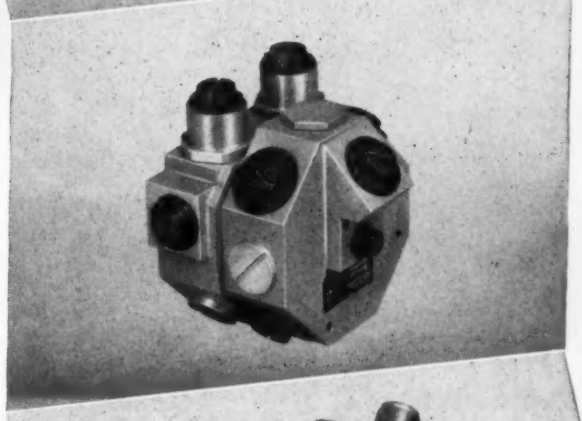
Fluid flowing through a hydraulic system gives up pressure energy in the form of heat loss or hydraulic friction. The amount of pressure loss is related to: operating temperature, oil viscosity, tubing diameter, length of tubing, surface roughness, velocity of fluid flow, and the number and size of bends, contractions and expansions in the system. All these factors are discussed in this analysis of pressure losses in the Flying Wing.

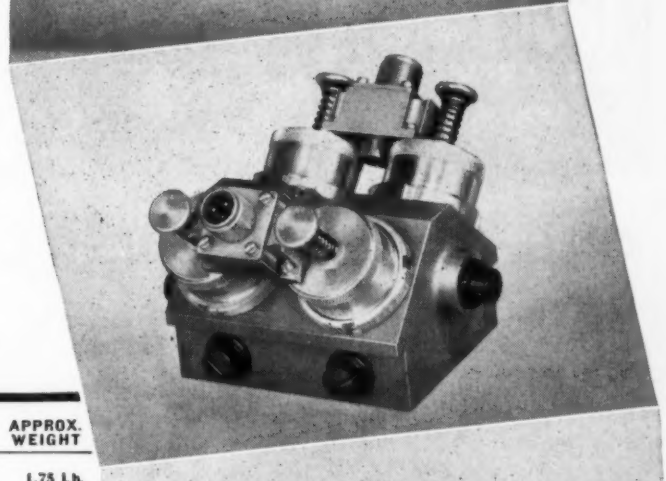
Figure 2 indicates a substantial increase in pressure loss between the temperatures of -30°F. and -65°F. Since modern day military aircraft are expected to function satisfactorily with ground ambient temperatures of -65°F, the advantage to be gained in warming the hydraulic fluid to -30° before take-off is readily seen. This is further emphasized by the fact that at -65°F the full pressure of a 1500 psi system is necessary to flow approximately 10½ gpm through .625 x .035 wall tube 23 feet long. At -30°F the pressure loss for the same tube at the same flow is approximately 190 psi.

Although comparative calculated and experimental values were obtained at one temperature only, the formulas and curves are believed reasonably accurate for other temperature conditions. Discrepancies of increasing proportion will probably occur at the extremes of low temperature due to variation in viscosity of AN-O-366 between suppliers of this fluid.

BENDIX-PACIFIC SOLENOID VALVES ARE READILY ADAPTABLE TO YOUR SPECIAL REQUIREMENTS







Bendix-Pacific engineers over the past 16 months have developed an outstanding new line of Solenoid-Pilot Operated Hydraulic Selector Valves. The extreme flexibility of this equipment makes it adaptable to a wide range of applications where unusually fast operating speeds and light weight are required. All electrical holding coils and switches have been eliminated from these new valves and they function with low current drain.

Listed below are a group of the valves recently ordered for latest military aircraft.

DESCRIPTION	REMARKS	ASSEMBLY NO.	APPROX. WEIGHT
3/8" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550680	1.75 Lb.
1/2" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550690	1.75 Lb.
3/4" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550700	3.1 Lb.
3/8" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. No Manual Over-Ride.	548690	1.75 Lb.
1/2" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. No Manual Over-Ride.	548570	1.75 Lb.
3/4" T.S. 4-Way Selector Valve	Cylinder Ports Connected to Return in Neutral with Solenoid De-Energized. No Manual Over-Ride.	548710	3.1 Lb.
3/4" T.S. 4-Way Selector Valve	Cylinder Ports Blocked to Return in Neutral with Solenoid De-Energized. No Manual Over-Ride.	551210	2.0 Lb.
1/2" T.S. 4-Way Selector Valve	Cylinder Ports Blocked to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550800	2.0 Lb.
3/8" T.S. 3-Way Selector Valve	Cylinder Port Connected to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550660	1.6 Lb.
5/8" T.S. 3-Way Selector Valve	Cylinder Port Connected to Return in Neutral with Solenoid De-Energized. Manual Over-Ride.	550585	2.2 Lb.
5/8" T.S. 3-Way Selector Valve	Cylinder Port Blocked to Return in Neutral with Solenoid De-Energized.	550630	2.2 Lb.
1/4" T.S. Dual Bank 4-Way Selector Valve	Cylinder Ports Connected to Return with Solenoid De-Energized. Manual Over-Ride.	550640	2.8 Lb.

Bendix

Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.

East Coast Office: 475 Fifth Ave., New York 17 • Export Division: Bendix International, 72 Fifth Ave., New York 11 • Canadian Distrib.: Aviation Electric, Ltd., Montreal

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LAB-CONTROLLED AND SERVICE-PROVED

1801.3 MILES OF WEAR WITHOUT LEAKAGE!*

GRC O-RINGS SEAL IT!

* This pump has a rugged assignment—continuous operation at 300 RPM and 4 inch stroke—24 hour day —5½ day week—supplying 2200 psi. water.

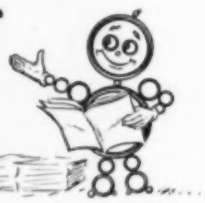
Conventional packing lasted only 5 days—caused costly and frequent shutdowns—correction was imperative!

Now—GRC O-rings seal it for 6 weeks plus—downtime is eliminated—repacking is on weekends in 6 minutes.

GRC O-ring Engineering had the economical answer—replace gland packings with simple adapters and precision GRC O-ring seals.

The services of our modern engineering lab are available to assist in solving your sealing problems too!

Write for Free GRC Catalog "C" and bulletin P.112



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MOLDED RUBBER SPECIALTIES, WASHERS

QUALITY MECHANICAL RUBBER GOODS FOR 35 YEARS

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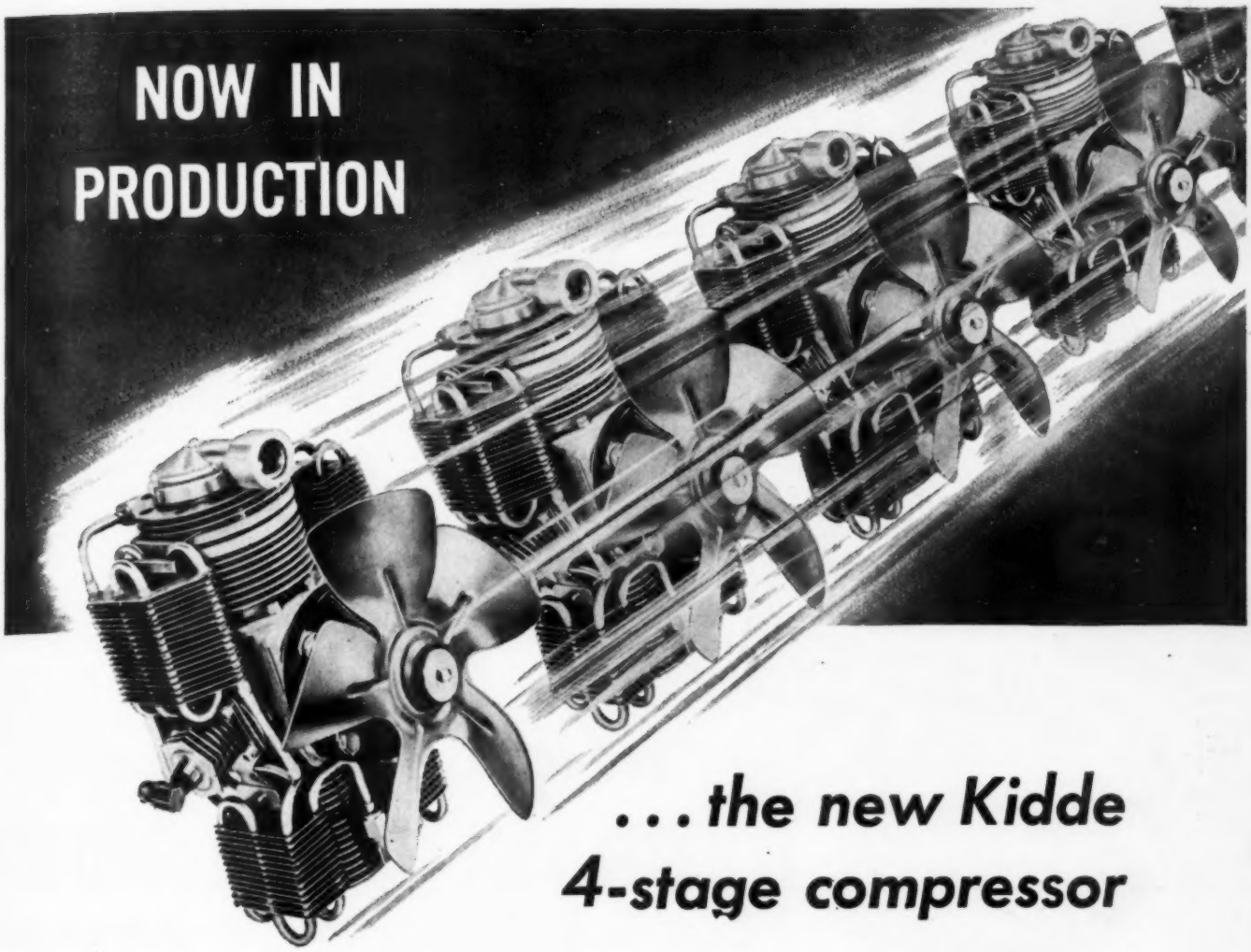
Better Cargo And Food Service

THE NEW "CHUCK WAGON" WHICH NORTHWEST Airlines has in operation at three of its major terminals is a specially designed, hydraulically operated cargo and galley service truck which has expedited this service at a definite savings in cost.

The truck, a standard 1½ ton Dodge chassis, is equipped with a high lift, double cylinder hydraulic hoist to raise the special steel body, 12 feet long, 8 feet wide and 6 feet high to any height between the truck bed height and 10 foot elevation. The truck is also equipped with a platform over the cab to permit easy and safe access to the aircraft galley service door through the forward door in the truck body when in the elevated position, and to permit positioning the unit at the aircraft in the minimum possible time and with maximum safety. A standard Anthony tail gate assembly is provided at the rear of the truck to assist in loading and unloading the heavy pieces of equipment or cargo which it handles.

The "chuck wagon" units were designed to provide the maximum maneuverability and dependability under all weather conditions for: transportation of either cargo or commissary supplied to and from the aircraft and to elevate this material between the ground and the aircraft service floor; to provide maximum protection from the elements for the material it handles; to provide maximum safety and better equipment for employees; and to reduce general operation costs of handling both commissary equipment and cargo.

Circle 39 on Reader Service Card



. . . the new Kidde 4-stage compressor

Kidde Aircraft Pneumatic Devices Include:

- AIR COMPRESSORS
- REGULATORS
- HIGH PRESSURE CONTAINERS & VALVES
- SELECTOR VALVES
- GUN CHARGERS
- RELIEF VALVES
- PRESSURE SWITCHES
- CHECK VALVES
- MOISTURE SEPARATORS
- PNEUMATIC FUSES
- BACK-PRESSURE VALVES

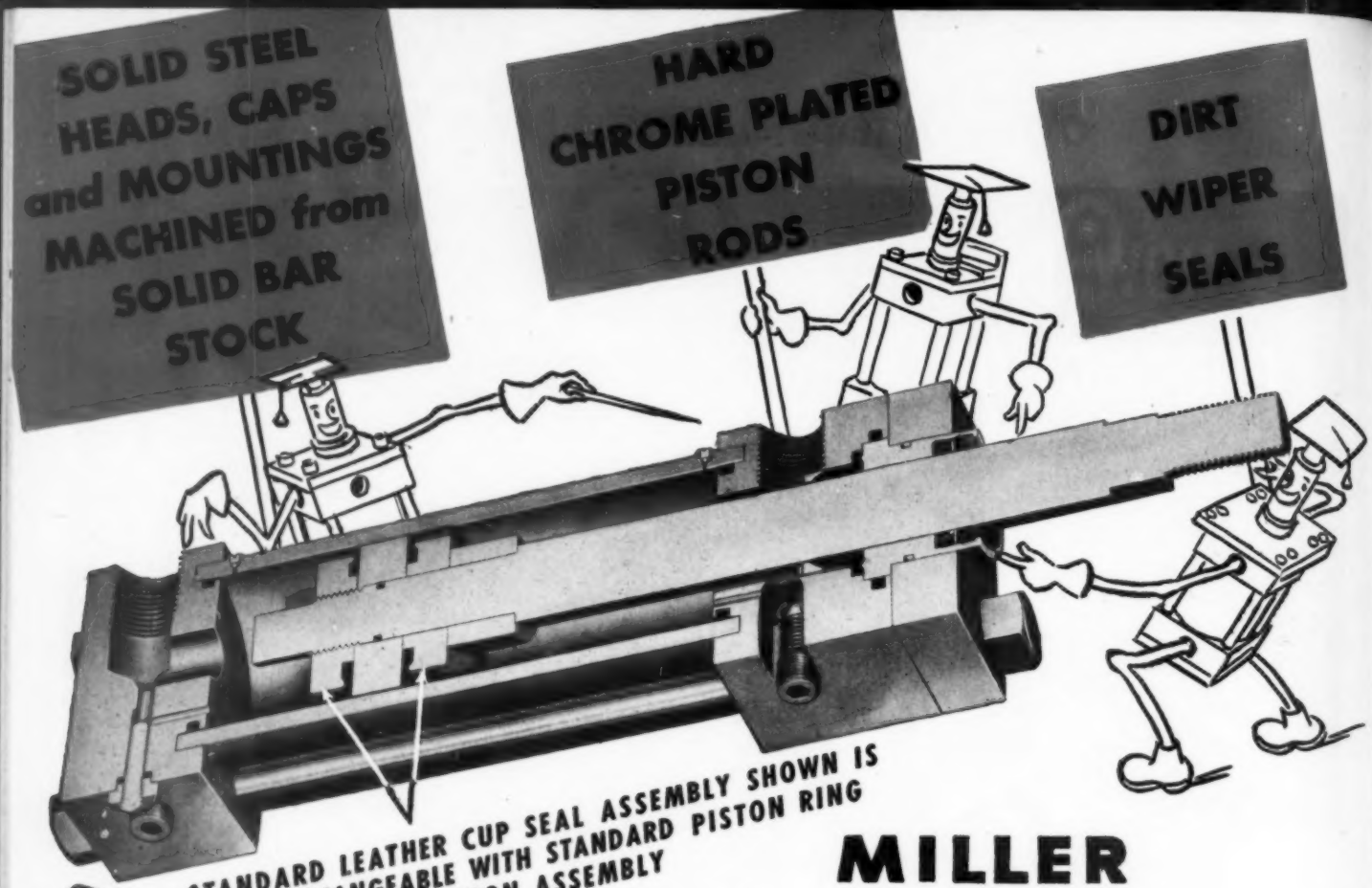
A lightweight compressor is now in production that makes pneumatic power practical in aircraft. This new Kidde compressor at 35,000 feet will, from ambient pressure, deliver *one* cfm of free air compressed to 3,000 psi. At sea level it will deliver *four* cfm of free air compressed to 3,000 psi. The sea level performance can be maintained at altitude when inlet air is pressurized.

This big step forward in pneumatics is the result of years of careful experimentation by Kidde engineers. It is the latest in the line of pneumatic developments listed in the box at left.

If you feel that a lightweight source of power can help you in actuating airborne equipment—get in touch with Kidde.

Kidde

Walter Kidde & Company, Inc., 516 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.



STANDARD LEATHER CUP SEAL ASSEMBLY SHOWN IS INTERCHANGEABLE WITH STANDARD PISTON RING PISTON ASSEMBLY

MILLER
High Pressure
HYDRAULIC CYLINDERS
Meet J. I. C. HYDRAULIC STANDARDS

(Write for FREE Copy of the "Standards")

Years before the Joint Industry Conference (J. I. C.) Standards for specifying "quality" hydraulic equipment were adopted, the *standard* design and construction features of Miller High Pressure Hydraulic (2000-3500 psi) Cylinders already included ALL the specifications for cylinders, seals and pistons now called for by the "Standards". Hard chrome plated, scratch-resistant piston rods and dirt wipers have long been standard Miller cylinder features yet are required by the "Standards" only under severe conditions.

Solid steel heads, caps and mountings which eliminate costly, dangerous breakage even under the severest operating conditions represent an "extra-quality" standard Miller cylinder feature which actually exceeds the high quality set by the J. I. C. Standards.

The Miller "Patented" Hydraulic Piston Rod Seal which has no manual adjustment and is automatically self-adjusting and wear-compensating to give life-long leakproof service without ever requiring any manual adjustment whatsoever . . . far surpasses the requirement of J. I. C. Standard H6.2.5 which specifies "Stuffing boxes for automatic packing shall be so designed as to prevent adjustment beyond the functional limits of the packing"

Benefits to You

No Broken Castings

No Scratch-Damage to Piston Rods, Bushings and Seals

NO COSTLY "DOWNTIME"
NO REPAIRS
NO MAINTENANCE
NO POWER WASTAGE

Write for illustrated cylinder bulletins A-105 and H-104

COMPLETE MILLER CYLINDER LINE INCLUDES: AIR CYLINDERS, 1½" to 20" BORES, 200 PSI OPERATION; LOW PRESSURE HYDRAULIC CYLINDERS, 1½" TO 6" BORES FOR 500 PSI OPERATION, 8" TO 14" BORES FOR 250 PSI; HIGH PRESSURE HYDRAULIC CYLINDERS, 1½" TO 12" BORES, 2000-3000 PSI OPERATION. ALL MOUNTING STYLES AVAILABLE.

MILLER MOTOR COMPANY

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AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS · COUNTERBALANCE CYLINDERS · BOOSTERS · AIR-HY

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HARTFORD — NEW YORK CITY — DAYTON — ST. PAUL — FORT WAYNE — INDIANAPOLIS
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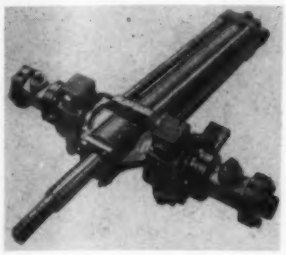
application and performance of NEW COMPONENTS

TRUNNIONED CYLINDERS USE RIGID PIPING — Benjamin Lassman & Son have introduced a trunnioned type cylinder for heavy duty oil applications to 3500 psi, which is designed to use rigid piping to eliminate the hazards of flexible hose. By equipping the integrally cast trunnion journals with swivel pipe connections permanent rigid installation of piping is possible while the cylinder may rotate through any angle in 360 degrees. Available in bores up to 12 inches and strokes to suit your application, these rugged cylinders use a forged steel piston rod and housing.



Circle 101 on Reader Service Card

AIR VALVE DESIGN STRESSES SAFETY — Greater safety for operators is provided by a new air control solenoid valve offered by Ross Operating Valve Company. The model, known as the Ross Safety Valve, was developed in cooperation with safety engineers. Even if the air or electrical supply should be interrupted, the valve is designed to move to a safe position. The elimination of all springs and the use of a clapper type solenoid adds to operators' safety. The valve ordinarily operates with line pressures of 40 to 125 psi, but it can be designed to work outside of these limits. Low in weight, it can be in-line or bracket mounted. The valve is available in ¼ to 1¼ in pipe sizes, straightway or 3-way, normally closed or normally open models.

Circle 102 on Reader Service Card

5000 PSI CHECK VALVES — A series of high pressure hydraulic check valves is now being manufactured by Greer Hydraulics, Inc. These check valves were developed to meet the operational requirements peculiar to high pressure, high flow circuits, especially where the contribution of surges normally produced by check valves has an adverse effect on the system.

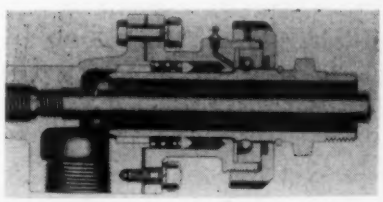
The principle feature of the check valve is that the action is dampened both in the opening and closing of the valve. This is accomplished by guiding a poppet on a hollow shaft which contains a dashpot chamber, and also houses the return spring. A calibrated orifice connects from the chamber to the outside of the downstream side of the valve. In normal service the chamber is filled with hydraulic fluid through the orifice. Under rapid flow conditions, the check poppet, in its opening motion, must displace the fluid entrapped in the chamber through the calibrated orifice. In the reseating of the poppet the fluid evacuated from the chamber must be replenished through the calibrating orifice. The action of the poppet is, therefore, snubbed in either direction preventing shocks and hammer.

Circle 103 on Reader Service Card

SPOOL TYPE VALVE, 2000 PSI SERVICE — Sturdily designed for a long, trouble-free service life, a new low-cost hydraulic control valve is announced by The Parker Appliance Company. The open center, single spool, 3-way valve is ideally suited to heavy duty service on farm implements, construction and materials handling machinery, for pressures up to 2000 psi. The valve features an externally adjustable, built-in, balanced relief valve sized to handle full pump capacity to 14 gpm. Pressure drop through the open center of the valve is held to only 10.25 psi at 14 gpm. Cylinder and pressure ports are available in ¼, ⅜ or ½ in pipe size, with a ¾ in return port.

Circle 104 on Reader Service Card

REVOLVING JOINT — Introduction of a new, compact improved type of revolving joint for making piping connections to rotating equipment is announced by Barco Manufacturing Co. Designated as Type LBR, the new joint is characterized by extremely low torque and is built for 200 psi hydraulic service at speeds up to 750 rpm, in sizes from ½ to 2 in. The rotating portion consists of a steel tube which screws into the hub of the rotating member. The non-rotating portion of the joint is ball bearing mounted on this tube. Self-adjusting, self-sealing chevron type packing carried under light spring pressure provides a long life seal on the rotating tube.



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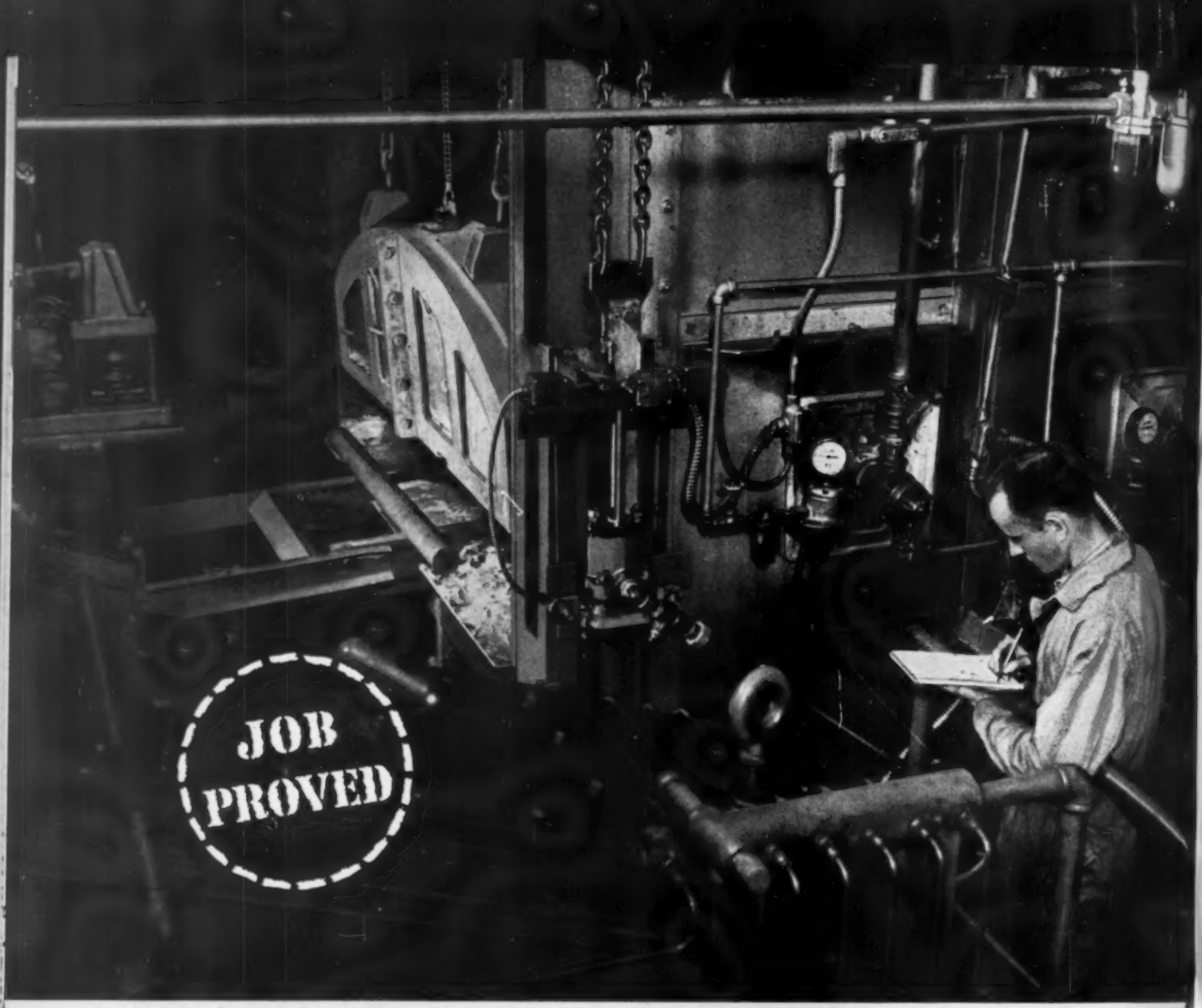

HYDRAULIC SYSTEM KEPT LIKE NEW

Sunvis 916 Effects Substantial Savings; Strainers and Lines Kept Sludge-Free

A copper tubing manufacturer uses an oven with hydraulically operated doors to heat billets to approximately 1550F. The ambient temperatures around the hydraulic mechanism are abnormally high, putting the hydraulic fluid to a severe test of stability. Failure of the system would halt the piercing operation and result in costly delays throughout the plant.

Since the oven was first put in operation, three years ago, the hydraulic fluid has been Sunvis 916. The original charge has never been changed and is still in excellent condition, though the system is tight and requires only a minimum of make-up. Oil lines and strainers are completely free of sludge. Seals and packings are sound. Operations are never interrupted for oil changes or parts maintenance. The company expects to retain the original charge of Sunvis 916 in service indefinitely, effecting large savings in both oil and maintenance costs.

Sunvis 916 is a solvent-refined oil of the highest quality. It is fortified to resist the oxidation and sludging so detrimental to the efficient operation of hydraulic systems. Sunvis 900 Oils are *good for the life of your machines*. For your copy of the illustrated booklet "Sunvis 900 Oils" write Department AH-5.

SUN OIL COMPANY · *Philadelphia 3, Pa.*
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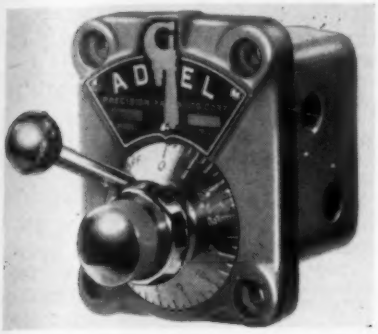
SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO

HYDRAULIC FLOW CONTROL VALVE — A versatile, 1500 psi, compensated type flow control valve, manufactured by Adel Division of General Metals Corporation, maintains constant flow over a wide differential pressure range. Adjustable from completely shut off position to 25 gpm maximum flow, the large 270 degree control lever rotation permits extremely accurate flow settings. The pressure compensated feature maintains substantially a constant flow regardless of variation in inlet and outlet pressure. Eight model variations are available.

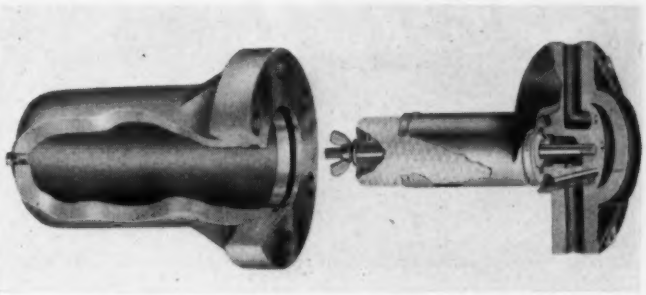


Circle 106 on Reader Service Card

BLEEDER TUBE TO REMOVE AIR FROM GAGE — "In place" bleeding of air from Heise Bourdon pressure gauges, permitting removal of all air without tipping the gauge, is claimed for a new bleeder tube, announced by the Heise Bourdon Tube Company, Inc. The bleeder tube, extends from the highest point in the Bourdon tube to an external block containing a vent screw, on the back of the case. Removal of the screw permits all air to escape. When the pressure medium escapes through the vent, the screw is replaced, and the gauge is ready for use.

Circle 107 on Reader Service Card

EXTRA-HIGH PRESSURE FILTERS — Microscopic clarification of liquids and compressed air at extremely high pressures is accomplished by an interesting new FULFLO filter recently developed by Commercial



Filters Corporation. Originally designed for use in filling steel high pressure containers with fuels for reaction engines, it has numerous other high pressure applications in the hydraulic and pneumatic fields. Designed for an operating pressure of 3000 psi, the model shown here is hydrostatically tested at 10,000 psi. Other models are available for operating pressures of 500 and 1500 psi. These new high pressure filters are now on a production basis.

Circle 108 on Reader Service Card

NO-RUST COMPOUNDS—A new addition to its line of No-Rust compounds has been anounced by the Gulf Oil Corporation. The new product is called Gulf No-Rust No. 6. The new compound is recommended for protection of metal surfaces against corrosion in either

Tell Us Your Production Problems . . . We'll Help You Solve Them

"LOGAN" AIR-DRAULIC® FEED-CONTROLLED CYLINDERS

• Power Movements In Any Direction • No Power Unit Required

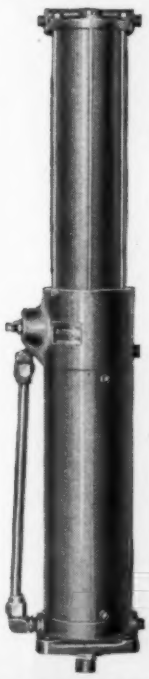
Combines

the fast-acting, economical, low pressure operation of AIR

with the smooth, uniform controlled regulation of OIL

5 STANDARD MOUNTING TYPES • Standard bores from 3" to 8". Any stroke to 5 ft. For air pressures to 150 p.s.i.

Furnished for controlled feed with rapid return in either direction, or with controlled feed in both directions. Skip feed movement can also be provided.



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Free Catalog On Request

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AIR CHUCKS — CATALOG 70-1
AIR CYLINDERS — CATALOG 100-1
AIR and HYDRAULIC PRESSES — CATALOG 51
COLLET GRIP TUBE FITTINGS — CATALOG 44
HYDRAULIC CONTROL VALVES — CATALOG 200-4
HYDRAULIC CYLINDERS — CATALOG 200-2; ALSO 80-2
HYDRAULIC POWER UNITS — CATALOG 200-1
SURE-FLOW COOLANT PUMPS — CATALOG 62

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Air and Hydraulic Equipment

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Bendix-Skinner

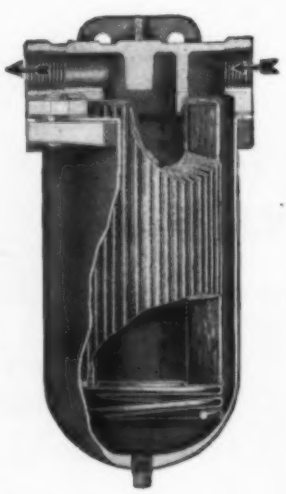
ORIGINATOR OF **MICRONIC** FILTRATION

Results Prove It

the *Finest*

Name in Filtering

Nine times out of ten ***Bendix-Skinner*** Filters will supply the "finest" answer to your filtration problems. Here are the facts: available with patented, exclusive, resin impregnated cellulose elements; simple, quick replacement; high flow rate with minimum pressure loss; no channeling or bypassing; over 350 models providing filtration from ½ micron (.000019") upwards at flow rates from 1 to 5000 g.p.m. Why not let ***Bendix-Skinner*** filtration engineers work with you? Write us direct.



Model 3110-P filter element, 6⅛" x 3½", has a filtering area of 940 sq. in.

Disc-type Ribbon-type Pleated-type

SKINNER PURIFIERS DIVISION OF

1503 TROMBLY AVENUE
DETROIT 11, MICHIGAN

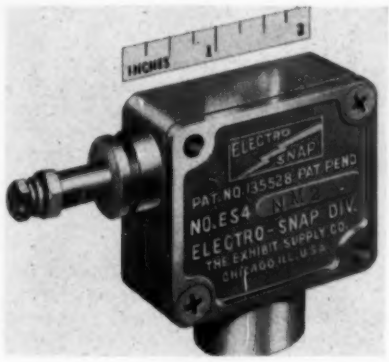
Bendix AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Ave., N. Y. 11, N. Y.

indoor or outdoor exposure during domestic and overseas shipment and for either indoor outdoor storage for long periods of time. It is a rust preventive of the thin film type and will provide approximate surface coverage of 390 sq ft per gallon. It will deposit a coating exceeding 8 thousandths of an inch in thickness by dipping at a temperature of 70 F, and will dry sufficiently within four hours to permit handling without removal of the coating.

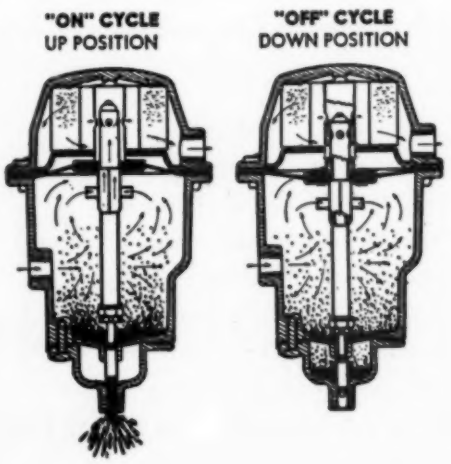
Circle 109 on Reader Service Card

MOMENTARY TYPE LIMIT SWITCH TRIPS SOLENOID VALVES — To momentarily pulse solenoid operated valves for air and hydraulic cylinder circuits, the Electro-Snap Division of The Exhibit Supply Co. have designed the ES4-NM limit switch series. The "on" type length is varied so that, depending on the speed of the actuating member, an "on" time can be selected that will give 1/10 to 2/10 second impulse to the momentarily pulsed valve. These limit switches are furnished in 1/16, ⅛ and 3/16 in standard lengths and can be furnished with "on" time lengths up to ⅜ in on special order. Use of these switches eliminates the need for one-way dogs. A simple flat dog can be attached to the cylinder piston rod to actuate this switch.



Circle 110 on Reader Service Card

VALVES REMOVE AIR CONTAMINANTS — This new line of valves for automatic removal of contaminants from compressed air lines has recently been



introduced by the Wilkerson Corporation. The valves eliminate manual attention or adjustment resulting in savings in man-hours, and repair parts. The cross-sectional view shows the Diaphragm Operated Valve. When the air line is not in use, the diaphragm is forced down by back pressure with the "O" ring sealing the sump bottom. As air is used, the pressure differential raises diaphragm and shaft, seals bottom of middle chamber, opens bottom of sump and blasts out contamination. All accumulated contaminants are discharged in each cycle.

Circle 111 on Reader Service Card

Circle 43 on Reader Service Card

NICHOLSON CONTROL VALVES *feature*

EASY MAINTENANCE

A survey of maintenance men shows 6 reasons for the increasing standardization on Nicholson cylinder control valves:

1) Specially treated hard seats that don't cut out.
2) Seating surfaces are protected from dirt and grit.
3) Metals, gaskets and gland packing to suit the service.
4) Generous stuffing box, easily repacked.
5) Heavy-bodied, take abuse.
6) Simplicity of design, minimizes maintenance time.

Nicholson standard and special valves in lever, foot, solenoid, motor types; for air, gas, oil, steam, water; size ¼" to 2½" press. to 5000 lbs. CATALOG 1250

W. H. NICHOLSON & CO. 213 Oregon St, Wilkes-Barre, Pa.

Sales and Engineering Offices in All Principal Cities

MONOPAK METALLIC PACKING

Prolongs the Life of Hydraulic Cylinders

Seals against Oil, Water, Brine, Air, Gases and Refrigerants

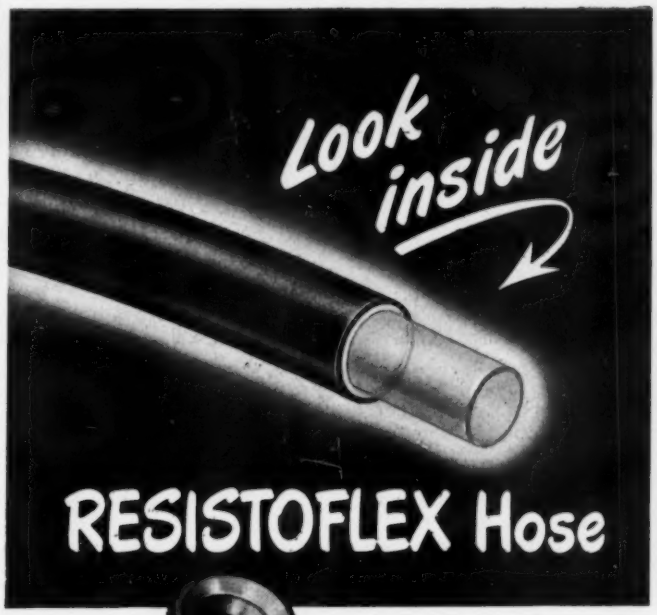
ASSURES UNEXCELLED DURABILITY

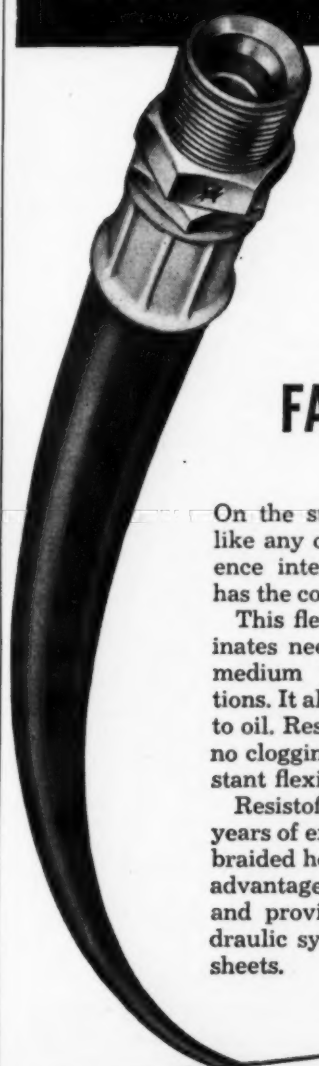
Burst-proof, does not blow out . . . Compact and easy to install . . . Low Friction insures long life. Now adopted by hundreds of manufacturers and users of machine tools.

Write for Literature

HYDRAULIC ACCESSORIES CO.
439 E. Fort St. • Detroit 26, Mich.

Circle 44 on Reader Service Card





...and you'll see why it's

OILPROOF!

FATIGUE-PROOF!

On the surface, Resistoflex hose looks like any other hose. But what a difference internally. Only Resistoflex hose has the compar tube.

This flexible, high tensile tube eliminates need for metal reinforcement in medium pressure hydraulic applications. It also makes the hose *impervious* to oil. Result: No erosion, no gumming, no clogging. And no fatigue under constant flexing conditions.

Resistoflex has proved skill and long years of experience in the fabrication of braided hose with synthetic tubes. Take advantage of the quality this assures and provide trouble-free, cleaner hydraulic systems. Write for specification sheets.

For out of the ordinary engineering with synthetics

RESISTOFLEX
CORPORATION
Belleville 9, New Jersey

Circle 45 on Reader Service Card

Useful Catalogs and Bulletins

available for reference

Large Portable Compressor . . . Issued by Ingersoll-Rand Company, an illustrated brochure describes the new type of large size portable air compressor. Designated as the Gyro-Flow 600, it delivers 600 actual cfm free air at 100 psi. Total weight is only 9,500 lbs ready for use, making the Gyro-Flow the lightest weight portable compressor in its capacity range. The two-stage, oil cooled rotating-vane compressor eliminates pistons, cam rods, valves, and the need for a clutch. Air is discharged at less than 200 F under normal operating conditions.

Circle 115 on Reader Service Card

Injection Molded "O" Rings . . . Minnesota Rubber and Gasket Co. offers Catalog 9A, a 10 page brochure, giving data on application and installation of "O" rings. Characteristics of 7 different synthetic rubbers are compared. These physical properties, as determined in their laboratories, will assist the user in selecting the proper packing compound to meet his specific job conditions. Sizes are tabulated and piston groove and cylinder bore dimensional recommendations are charted. Drawings of typical static and dynamic sealing jobs are shown.

Circle 116 on Reader Service Card

Manual of Valves for Pressures to 6000 psi . . . Here is a conveniently arranged, well illustrated booklet issued by Barksdale valves. Called Catalog 1B-1, manual valves, selector, shut-off, dual pressure and manipulator valves are detailed. Dimensional and porting data is laid out to assist the designer in their application. Simple, handy procedure data for selecting the proper valve is given. Charts giving hydraulic ram capacities and pipe size data help in the selection. The catalog contains explanatory copy and illustrations of the patented "Shear-Seal" principle: A pressure balanced, self aligning, tubular valve seal maintains intimate contact with an optically flat porting disc. Flow passages are opened or closed by the rotary movement of this disc. Fluid flow is always through the center of the seal, never across sealing surfaces.

Circle 117 on Reader Service Card

Packings and Oil Seals . . . This condensed catalog prepared by Johns-Manville covers their line of packings and friction materials. Of particular interest to the user of pneumatic equipment are the moulded packing cups available in cup, flange and U shapes. Cut gaskets made from sheet packing materials and metallic Goetze gaskets are shown. Service recommendations for all shown packing types are charted. Design and application of J-M Clipper Seals are shown.

Circle 118 on Reader Service Card

Pipe Plugs and Set Screws . . . Set Screw & Mfg. Co. has prepared 12 page Catalog No 12 giving information on both slotted and socket head pipe plugs along with complete data on set screws. Dimensional charts and drawings clearly show standard sizes and the six styles of set screw points. Pipe plugs milled from bar stock are made in 1/16 to 2 in sizes, with ⅛, ¼, ⅜ and ½ in socket pipe plugs carried in stock. Tables give thread data for American Standard screw threads.

Circle 119 on Reader Service Card

Control Valves of Flat Disc Design . . . Built for manual solenoid or direct motor coupled operation, control valves, built by W. H. Nicholson & Co. are detailed in 14 page Catalog 1250. Two-3-and 4-way valves are built in the flat disc design to handle a variety of fluids at pressures up to 5000 psi. Cross-sectional drawings clearly show this rugged, heavy-duty construction. Dimensional data and porting arrangements are charted. Lever operated valves are made in styles for control by hand or foot. Application data of all valves is given. Valves actuated by direct motor drive can be remotely controlled from a push button station.

Circle 120 on Reader Service Card

Hydraulic Pumps . . . Brown & Sharpe, again makes available, their catalog illustrating design and application of geared, vane and centrifugal pumps. Performance charts quickly give discharge and horsepower ratings over the pressure and speed range. Gear pump design includes both helical and spur gears, with flanged and foot mountings. These pumps are for low pressure, 100 psi applications. The 500 series herringbone geared pumps, made for pressure use to 500 psi are fully detailed with performance curves and construction data.

Circle 121 on Reader Service Card

Filters for Pneumatic Control Systems . . . With emphasis on the well known Staynew Double Action principle, this new 8 page, file size bulletin issued by the Dollinger Corporation, illustrates and gives applications and specifications for 76 filters, including pressure and vacuum types. These filters provide both mechanical separation and filtration. A deflector cup directs the flow of air or gas together with entrained water, oil and other foreign matter to the walls of the filter housing, and then downward at high velocity to the base. Here the contaminants are deposited and drained off when necessary. The mechanically cleaned air rises at lowered velocity through the radial fin insert which removes the lighter airborne material by positive filtration. Installation views are shown in this latest bulletin of the new Series 600 Filters, built for air pressure up to 6000 psi.

Circle 122 on Reader Service Card

Automatic Hydraulic Regulator . . . Drawings and bulletin sheets are available from Shallcross Controls Inc., describing their control devices for regulating pressure, volume and flow for sensitive actuation of hy-

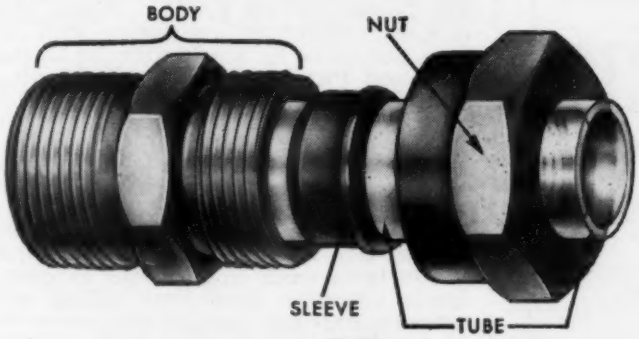
FOR THE ONE MAN IN YOUR ORGANIZATION

TO WHOM **Fittings** ARE **Important**

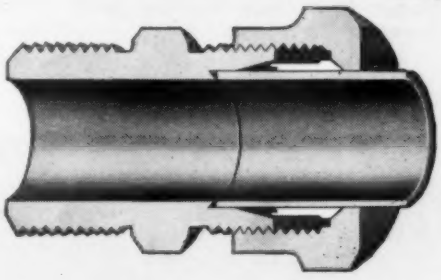
We Developed

"ERMETO®"

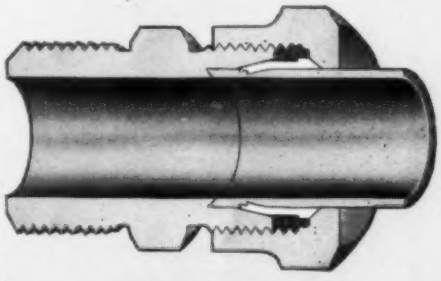
Now you can make tube and pipe connections at 1000 psi and above with NO FLARING, NO THREADING, NO WELDING, NO SOLDERING! The patented design of Weatherhead ERMETO Fittings permits installation with no tools but a wrench. Easy to take apart and re-tighten with a pressure tight joint. *Maintenance time saved is production time earned!*



1. Sleeve is heart of Ermeto Fitting. Sleeve and nut slip onto tube; end of tube inserts into body of fitting.



2. Tighten nut; pilot of sleeve contracts engaging outer surface of tube.



3. Fully tightened. Tube end butts tight against body shoulder. Nut presses sleeve bevel causing entire sleeve to clamp tube. Forces acting on sleeve cause it to bow, give it a spring action which holds tension between body and nut—prevents loosening.

You can forget psi when you specify ERMETO. Designed for high-pressure use, ERMETO Fittings have so simplified and cut costs that it pays to standardize on ERMETO FOR ALL JOINTS. The advantages in simplified inventories are obvious. ERMETO meets J. I. C. requirements. Made in sizes ⅛" to 2" O. D. in steel, stainless steel and brass.

WRITE FOR DETAILS—get catalog No. E-1457. Address—The Weatherhead Company, Dept. A, 300 E. 131st Street, Cleveland 8, Ohio.

FIRST IN HYDRAULIC CONNECTIONS

WEATHERHEAD

Plants at Cleveland, Ohio; Angola and Columbia City, Indiana; and St. Thomas, Ontario

The Mark of Quality

draulic cylinders. Regulators, consist of (1) sealed-in oil sump, (3) direct driven oil pump, (3) pressure differential sensing mechanism and (4) a frictionless control valve. Depending on the application, a diaphragm, bellows or bourdon tube may be used as the sensing device. This is a complete, sensitive, power package for low pressure, approximately 150 psi, applications. The bulletin also illustrates the power cylinder, controlled by the hydraulic regulator.

Circle 123 on Reader Service Card

Tube Finishing Machines . . . Users of hydraulic tubing requiring deburring or chamfering will be interested in a new four page bulletin issued by Pines Engineering Co., Inc. describing their bench type and finishing machine. Both hand and air operated units are shown with typical application photos and tooling diagrams. Tubing to 2 inches in diameter can be handled.

Circle 124 on Reader Service Card

Oil Company's 75th Year . . . A new 24-page brochure commemorating the company's 75th anniversary has been published by the Brooks Oil Company, of Cleveland and Pittsburgh. Combining both technical data and historical information about the company, this booklet traces Brooks' history from its beginning as a lamp oil producer to its position today as one of the largest compounders of industrial lubricants.

Included in the technical section are details on Brooks Leadolene, Klingfast and Roll Oil F. Over two dozen case histories are cited which indicate how Brooks lead-base lubricants have compared with other products on such applications as open and enclosed gears, corrosion protection, rolling mills, circulating systems, bearings, leaking gear cases, railroad switch-plates and track curves, gear reductions and wire drawing machines.

Circle 125 on Reader Service Card

AN UNUSUAL OPPORTUNITY

We have an opening for an advertising salesman in our Chicago territory.

It is necessary that this young married man be familiar with general industrial processes, including hydraulic and air circuits and their components.

We'll teach him the advertising business. Salary to start. Incentive plan when trained.

APPLIED HYDRAULICS
Magazine
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Perkins Hydraulic Power Unit
Application – Proved
Perkins Hydraulic Power Unit combines high efficiency and quiet operation . . . completely enclosed for maximum safety . . . The Perkins Unit is proving high worth in a wide range of applications. Made by manufacturers of long and broad experience in the design and manufacture of quality industrial machinery.
B. F. PERKINS & SON, Inc.
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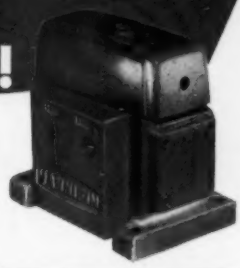
HOLYOKE, MASSACHUSETTS
Manufacturers of Industrial Machinery Since 1873

Circle 48 on Reader Service Card

SOLVES Many Air Control PROBLEMS!



Model NE Electric Valve Controls Single- or Double-Acting Air Cylinders

10 WATT SOLENOIDS—Little power needed because air does the work. No relays, no transformers required. Operates directly off regular 110 or 220 v. circuits. Solenoids continuously rated.

FAST, EFFORTLESS CONTROL—Works by push button, limit switch, or any light contact. Only momentary contact needed. Ideal for remote control . . . interlock or sequence operation . . . building into equipment.

DISC TYPE—Metal-to-metal seat; self-lapping; positively air-tight. Air-actuated piston shifts main disc; solenoids merely open and close ports which control piston. Action is quiet, quick.

HANNIFIN ENGINEERED—Small, rugged, self-contained. Type 1 for control of advance and return cylinder strokes through separate push buttons. Type 2 for single push button control—equivalent to spring return valve action. Sizes ⅜", ½", and ¾". 25 to 150 p.s.i.

Ask for Bulletin 230

HANNIFIN *Corporation*

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Nationwide Sales and Service

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★ REDUCE DOWNTIME WITH HILCO

HYDRAULIC OIL FILTERS...

THEY KEEP YOUR OIL CLEAN BY REMOVING PRODUCTS OF OXIDATION, ACIDS, SLUDGE AND MOISTURE

HILCO FILTERS WILL PREVENT SLUDGING, PUMP AND VALVE FAILURES...

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THE HILLIARD CORPORATION
148 W. FOURTH ST., ELMIRA, N. Y.

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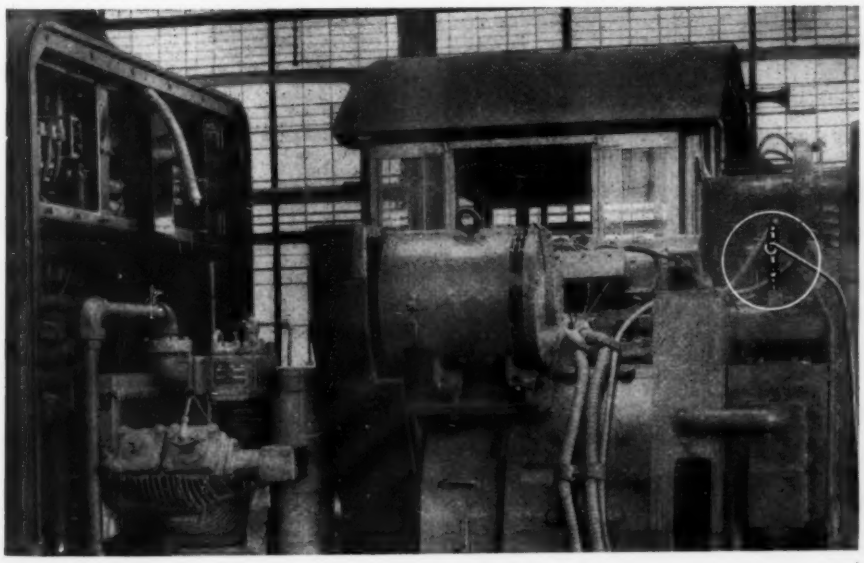
990 BAY ST., TORONTO-3464 PARK AVE., MONTREAL



Constantly on Duty to Maintain *Constant* Pressure on this Diesel engine built by

BALDWIN-LIMA-HAMILTON CORP.
(Lima Works) Lima, Ohio

TRADE MARK FULFLO REG. U. S. PAT. OFF.

BY-PASS OIL-RELIEF VALVES

Precision-engineered . . . with five springs for pressure selection.

CHATTERLESS . . . easily installed . . . no further attention required.

Pipe sizes: ¼" to 2" standard pipe thread and STD 300 lb. American flange valves 1" to 2½".

SILENT! VALVES AT WORK!

WRITE on your letterhead for FULFLO MECHANICAL DATA BOOK

TRADE MARK FULFLO REG. U. S. PAT. OFF.

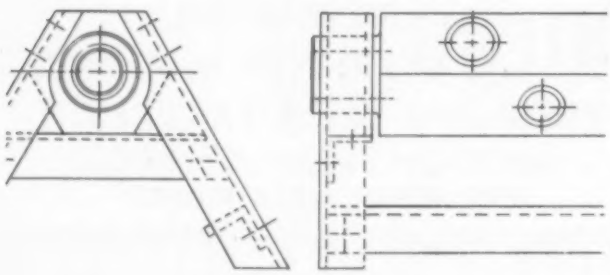
Specialties Co., Inc.
BLANCHESTER, OHIO

HERE'S HOW

- PREVENTIVE MAINTENANCE
- SERVICE PROCEDURES
- MODERNIZATION
- SHORT CUTS

Fixture Speeds Valve Testing

HERE IS A FIXTURE WHICH WE USE TO TEST MORE than a dozen valves at one time. Three different sizes are handled in the one fixture.



WELDED CONSTRUCTION
3/4 X 3/4 X 1/8 ANGLE IRON FRAME

You will note from the sketch that the 2 inch hexagonal "tube", which is approximately 32 inches long, is mounted in an angle iron frame. The ends of the hex stock have been turned round to act as bearing ends so that the hex unit can be rotated in the stand. Bearing blocks are welded in the frame.

Forty ports for mounting valves are drilled. There are 20 for ½ in valves, 10 for ⅜, and 10 for ¼ in.

This stand is used on hydraulic leakage tests where pressure is applied for the test time interval to give stabilization and then the pressure drop is measured. Before this fixture was made, only one valve could be tested at a time, causing the operator to spend a great deal of time waiting between readings.

HARRY P. KUPIEC
Air Associates Inc.
Teterboro, N. J.

Oil reservoirs . . . should be mounted at a higher level than the pump whenever possible. It has been found that this results in greater efficiency of the pump as the gravity feed fills the pump gears and avoids vacuum pockets. This also results in quieter operation of the pumping unit.

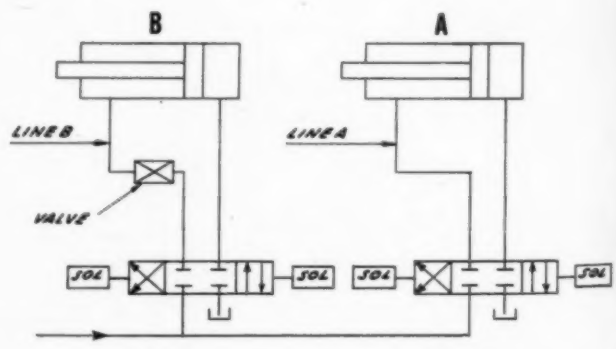
Valve Compensates for Pipe Friction To Equalize Cylinder Travel

ON A SPECIAL DOUBLE HEAD BORING MACHINE IT is necessary that each boring head advance at the same rate of speed. Basically piston travel is a function of oil delivered and piston diameter.

$$\text{Rate of Piston Travel} = \frac{\text{Pump Delivery}}{\text{Working area of piston}}$$

When the machine was built, both cylinders were identical in size and supplied by a fixed capacity pump through piping of the same diameter, it was felt that all conditions were met for giving the same travel to both heads.

But — PIPE FRICTION LOSSES created unequal travel. Due to fixed locations of the head cylinders, piping lengths to each cylinder were unequal. Line A was considerably longer than line B. Fluid friction losses in A made cylinder travel in that circuit slower than the speed of the other head.



To correct this situation, a globe valve was put in line B. The globe valve increases the friction loss in line B and by adjusting its opening, the speed of cylinder B was made equal to that of cylinder A.

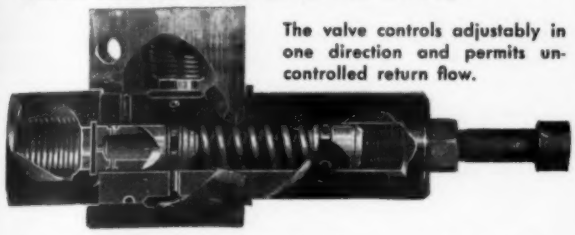
HARRY VON HOENE
Cincinnati, Ohio

Submit your design hint or labor saving idea. BEST OF THE MONTH earns $10. Every published item brings you $5.

Circle 53 on Reader Service Card

An adjustable FLOW REGULATOR

This newly perfected adjustable Flow Regulator holds at a constant rate even though the pressure fluctuates.



The valve controls adjustably in one direction and permits uncontrolled return flow.

The spring back piston in the housing is mounted in front of the adjustable screw. It carries a calibrated orifice; operates axially on change in inlet pressure so as to increase the throttling action.

Four sizes, ¼, ⅜, ½, and ¾ inch. Overall length, 4½ to 7½ inches. Adjustable over a 50% flow range. Maximum pressure is 3000 pounds.

Write for illustrated circular.

West Coast: H. E. Webb
918 North Kenilworth Avenue Glendale, California

WATERMAN ENGINEERING *Company*
721 CUSTER AVENUE • EVANSTON, ILLINOIS

Quick-As-Wink AIR AND HYDRAULIC **Control Valves**

No. 1551-N3 Neutral Position ¾ Inch 3-Way Air Valve

HAND OPERATED Air Valves

Thousands of Uses Throughout Industry

● Universally used and endorsed. Valving mechanism has stainless steel body and push-pull rods, brass sleeves, self-sealing U-packers and many other refinements, all fully enclosed against dirt, assuring long efficient trouble-free operation. No metal to metal seating. ⅜" to 1½" sizes, 3-way and 4-way, neutral position and regular actions. Pipe header mounting plates furnished if desired. *Write for full details.*

Quick-As-Wink AIR AND HYDRAULIC **Control Valves**

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1968 E. Pershing St., Salem, Ohio

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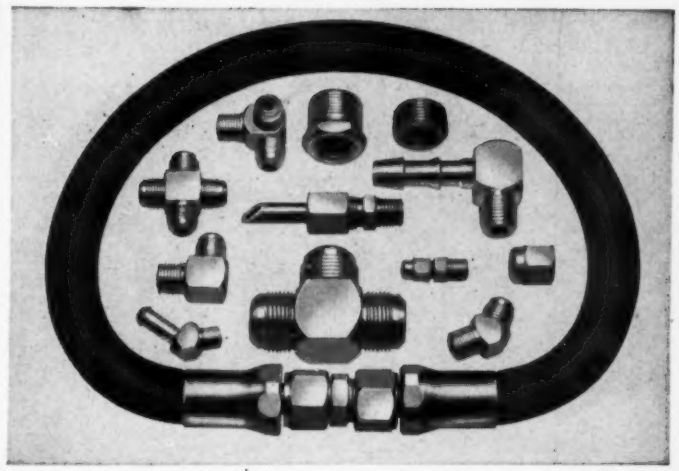
WHEN YOU CHANGE TO J. I. C. Standards

LET L & L SERVE YOUR HYDRAULIC PIPING NEEDS



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  for ⅛th to 2 inch O.D. tubing
  2 PIECE TITE-SEAL FOR ECONOMY
  3 PIECE LOCK-JOINT-SLEEVE TYPE
- **HOSE ASSEMBLIES**
  with pressed-on coupling for single and double wire braid hose
- **PIPE FITTINGS**
  Straight, Ells and Tees with "Dry-seal" pipe threads (N.P.T.F.)
- **PRE-FABRICATING TUBES**
  Let us estimate your preformed tube assembly needs.

Write for catalog and technical data. We also have technical and sales representatives in your area for your convenience.

Hydraulic Accessories

L & L Manufacturing Co.

8088 EAST NINE MILE RD. VAN DYKE, MICH.

Circle 51 on Reader Service Card
Circle 52 on Reader Service Card

Form Hooks Fast

(Continued from page 37)

of the valve, oil flows freely from pump to tank, and the cylinder ports are blocked. To operate the cylinders, solenoid A is energized to direct oil from port P to B to the head end of the clamp cylinder. After the part is firmly clamped, pressure builds up to open the sequence valve permitting oil to flow to the forming cylinder which moves toward the left to rotate the spindle.

It is the cylinder, not the piston, which moves to perform the bending operation. The rack that engages the pinion on the spindle is attached to the rectangular exterior of the cylinder which slides in ways; and the pressure oil is admitted to the cylinder chambers through holes drilled in the piston rods from its extremities to points adjacent to the piston.

Return of Forming Spindle

Reversal is accomplished by a limit switch which is adjustable to vary the degree of rotation of the bending spindle. Tripping of the limit switch deenergizes solenoid A and energizes solenoid B. Oil now moves from port P to A to return the spindle. The clamp cylinder is spring returned.

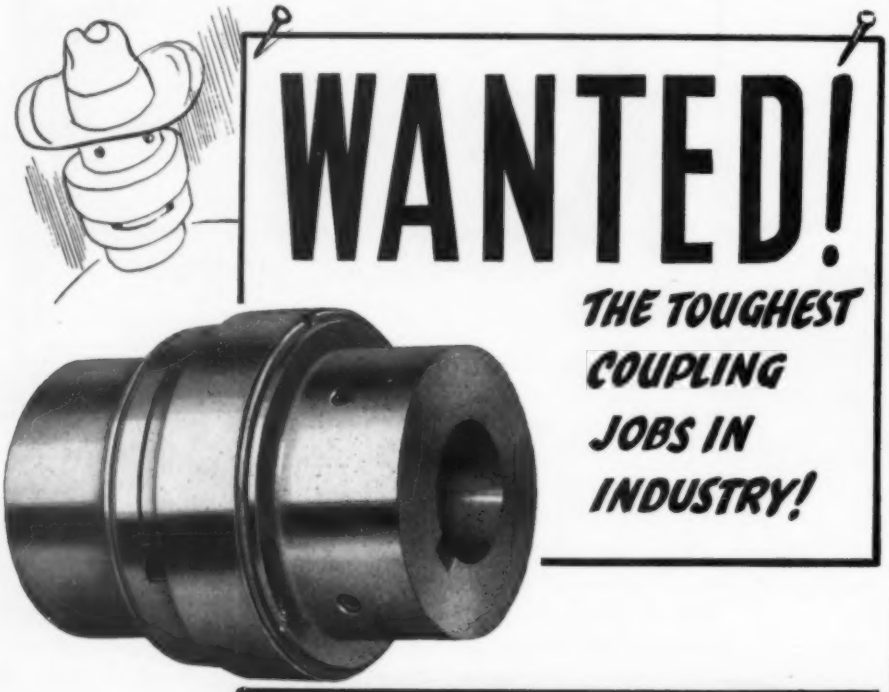
This machine, by changing mandrels, can produce hooks up to an outside diameter of 6½ inches. After the eye is bent, the mandrel is mechanically withdrawn to permit the work to fall free or be manually stripped from the machine. While recommended capacity is 1 in diameter rod, hot, around a 1½ in mandrel, it is impossible to damage the machine due to overloading because the relief valve will unload the oil pressure to stall the machine.

Control for single cycling is obtained by means of a foot button on a flexible cable, attached so that it may be located at any convenient spot.

Continuous operation, 20 strokes per minute, is also provided and the machine is equipped with an inching button for use when setting dies.

Submit Your Ideas

Tell us "Here's How" you do it at your plant. Sketch or jot down your labor-saver and send it in to the Editor—It may be worth $10.00 Every item published is worth $5.00, the best-of-the-month $10.00.



LOVEJOY

L-R FLEXIBLE COUPLINGS

The toughest coupling jobs in industry are handled with ease by rugged Lovejoy Flexible Couplings. Maintenance free Lovejoy Flexible Couplings counteract maximum misalignment, vibration, backlash and surge. Free-floating load cushions are suspended between heavy-duty metal jaws. Cushions are available for every duty . . . 1/6 to 2500 HP . . . and THERE ARE NO SHUT-DOWNS FOR CHANGING CUSHIONS. With Lovejoy Flexible Couplings, there is never any lubrication needed. For the difficult, as well as the easy coupling jobs in your plant, specify Lovejoy Flexible Couplings.

Write for catalog and Quick-finding Selector Charts.

LOVEJOY FLEXIBLE COUPLING CO.
5037 W. LAKE ST. CHICAGO 44, ILLINOIS

Also Mfrs. of Lovejoy Universal Joints and Lovejoy Variable Speed Transmissions.

Literature and Services In This Month's Ads

(Concluded from page 26)

REMOVE CONTAMINANTS from compressed air with a new valve type filter described in a 12 page catalog issued by Wilkerson Corporation.

Circle 30 on Reader Service Card

MECHANICAL SEAL, all in one package, is detailed in Sealol Corporation's drawing B-7100 which is offered along with engineering recommendations and bulletins.

Circle 63 on Reader Service Card

CONTROL VALVES for rugged, heavy-duty service on air and oil applications are illustrated in Catalog 1250 issued by W. H. Nicholson & Co.

Circle 43 on Reader Service Card

VISIBLE TYPE AIR LINE FILTER, regulator and lubricator assembly for protecting pneumatic control systems is illustrated in literature prepared by M-B Products.

Circle 61 on Reader Service Card

TECHNICAL DATA describing the performance of E. F. Houghton & Co.'s Hydrodrive, treated hydraulic fluid, is available.

Circle 28 on Reader Service Card

"O" RING DATA is given in Plastic and Rubber Company's comprehensive catalog which illustrates applications and design.

Circle 72 on Reader Service Card

AIR AND OIL CYLINDERS with new package type packing gland are detailed in engineering bulletins prepared by Petch Manufacturing Company.

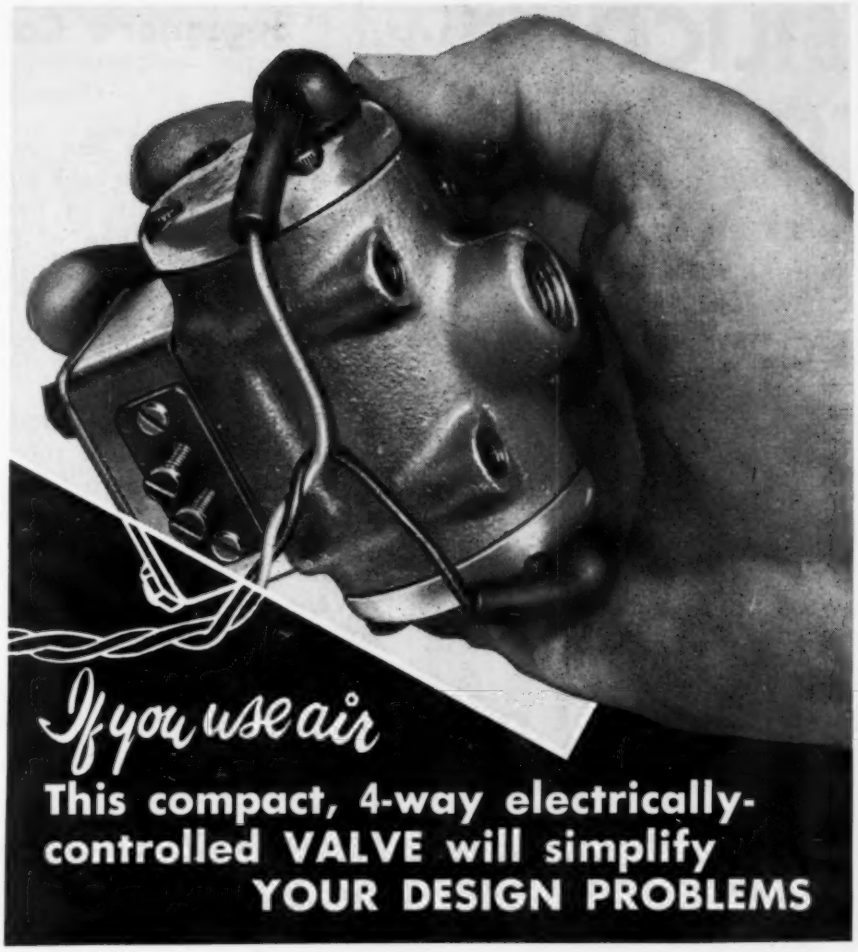
Circle 70 on Reader Service Card

CASE HISTORIES, wiring diagrams and technical data on the Electroaire valve and other Bellows air equipment are given in Bulletins AV 300 and CL-30.

Circle 55 on Reader Service Card

AIR MOTOR APPLICATION IDEAS are presented in a bulletin prepared by Gast; 26 design problems are solved.

Circle 60 on Reader Service Card



If you use air

This compact, 4-way electrically-controlled VALVE will simplify YOUR DESIGN PROBLEMS

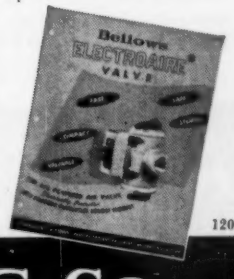
The Bellows air-powered, electrically-controlled air valve is so fast it will complete 2000 or more movements a minute. Yet its unique low voltage solenoids will operate all day without discernible hum, pounding, or overheating. So sturdily built, in fact, that we guarantee its solenoid control units against burnout.

The Bellows Electroaire Valve* is so compact it can be held in the palm of a hand, yet it combines in one complete unit a four-way directional valve, piston speed regulators, and low voltage electrical controls. It will operate safely and efficiently even if submerged, covered with coolant, or piled high with dirt or chips. It is self-adjusting to widely varying air pressures . . . operates on 5 to 150 lbs. of air.

Made in ¼", ⅜" and ½" port sizes, the Bellows Electroaire valve can be adapted for direct connection to, or remote control of any standard air cylinder. It is a built-in feature of all Bellows "Controlled - Air - Power" Devices arranged for electrical control.

Write for These Free Bulletins

Case histories, wiring diagrams, technical data on the Electroaire Valve and other Bellows pneumatic equipment. Ask for Bulletin AV-300 and CL-30. Address: The Bellows Co., Dept. AH551, Akron 9, Ohio.



*TM Registered — Patent Pending

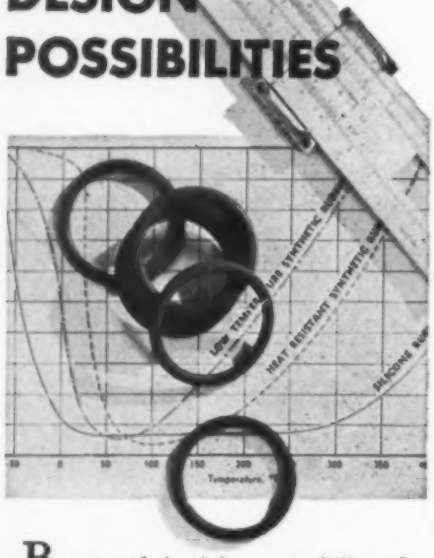
1201

The Bellows Co.

AKRON 9, OHIO

FASTER, SAFER, BETTER PRODUCTION — WITH "CONTROLLED-AIR-POWER"

SILICONE "O" RINGS OFFER UNIQUE DESIGN POSSIBILITIES



Because of the inherent stability of silicone rubber, Arrowhead "O" rings molded of this remarkable new material provide a long-lasting seal under conditions far beyond the limits of ordinary rubbers. For example, they remain flexible at -130° F.; withstand indefinitely, exposure to temperatures of 500° F. and over. They offer excellent resistance to oxidation, to many oils, acids, alkalies and a variety of chemicals. The ideally inert characteristic of these seals is demonstrated by their astonishing resistance to aging, even at abnormally high temperatures. At normal temperatures they last *indefinitely*. For superior performance under severe conditions, consider silicone rubber. Arrowhead's *silicone specialists* will welcome your inquiry.

Write FOR ENGINEERING DATA

Free to Engineers—two valuable new publications on silicone rubber and "O" rings. Contain complete technical and descriptive data, including typical applications.

ARROWHEAD RUBBER CO.

Division of
National Motor Bearing Co., Inc.
DOWNEY (Los Angeles County) CALIF.

"O" RINGS ▼ SILICONES ▼ AIRTRON ▼ DUCTS

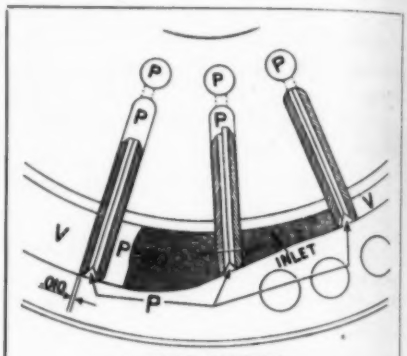
Beginner's Course — Vane Pumps

(Continued from page 43)

uses two vanes in one vane slot mounted back to back with beveled edges, Figure 14. Pressure from the bottom of the vanes can reach the top to practically balance the vanes. This design is claimed to minimize contact friction and therefore reduce wear.

Both the Vickers and Dudco designs have balanced rotors. Two intakes and two outlets diametrically opposite each other provide this balance. Figure 12 explains the design.

Vane pumps are built in both constant and variable delivery models. Racine adjustable volume Model J, Figure 11, uses threaded studs to move the pressure chamber ring, changing the amount of eccentricity between the ring and rotor. This permits setting the pump to deliver the exact volume of oil required by a given job.



P — INLET PRESSURE
V — OUTLET PRESSURE

Fig. 14. The double vane design used on Dudco pumps assures vanes which are hydraulically balanced. Pressure at the top of the vane can reach the bottom to provide balance. Sealing is effected by the .010 inch chamfer.

Capacity is adjustable from 0 to 15 gpm.

(Continued on next page)

Some of
AMERICA'S LARGEST PUMP MANUFACTURERS
rely on
PROMET
THE Engineered BRONZE

THRUST PLATES
BEARING PLATES
PRESSURE PLATES
CONNECTING RODS
BUSHINGS • SEALS

machined or rough cast and of the specific formula best suited to the application.

A MONEY-BACK GUARANTEE OF LONGER SERVICE

Send blueprints, conditions of operation and other data for recommendations and quotations.

Write for literature today.

THE AMERICAN CRUCIBLE PRODUCTS CO.
1303 Oberlin Avenue • Lorain, Ohio

10-DAY DELIVERY!

SIMPLEST... MOST COMPACT

O-M

AIR HYDRAULIC WATER CYLINDERS

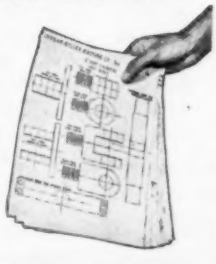
Add up these advantages. They are the reasons why more and more equipment manufacturers are specifying Ortman-Miller cylinders for all types of applications.

Simplicity of design eliminates tie rods and bulky end caps . . . saves one-third in installation space. All parts and mounting brackets interchangeable bore for bore. Cost less to buy, install and service. Full range of sizes (1½" to 8" bores) **available for early shipment.** Machined steel (no castings) and bearing bronze throughout.

Write today for details! Speed production, cut costs and save space with Ortman-Miller cylinders.

FREE TEMPLATES

For the first time in the industry, O-M offers a complete set of templates showing all cylinders and mounting brackets. ½ scale. Your set on request.



ORTMAN-MILLER

MACHINE CO., INC.

1204 150th Street, Hammond, Indiana
Circle 59 on Reader Service Card

Beginner's Course

(Concluded from preceding page)

A pressure compensated pump, one which will change delivery automatically to meet the varying job requirements is shown in Figure 13. This design automatically gives full delivery for rapid travel and just enough delivery to maintain leakage loss at the holding pressure. This holding pressure can be varied by adjusting the tension on the large top spring.

The Racine variable delivery, pressure compensated pump uses a spring, inside the bottom screw plug which tends to force the pressure ring toward the neutral, no delivery position. Opposing this action is the top spring which is acting against a differential plunger. Hydraulic discharge pressure acting on the differential area opposes the action of the top spring making movement sensitive to oil pressure.

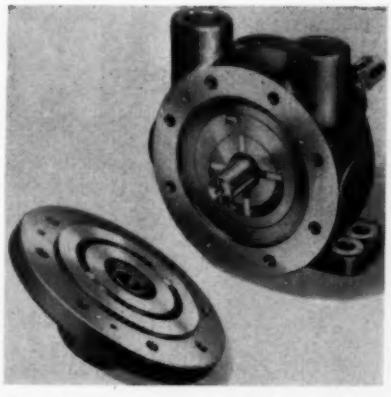


Fig. 15. Vane design also offers efficient handling of fluids at low pressures.

Because of their high ratio of volume delivered to actual size, vane pump designs are widely used as circulating and lubrication pumps. Figure 15 shows the design of the Brown & Sharpe automatic reversing vane pump for this low pressure, 100 psi, type of service. Unidirectional delivery is supplied regardless of shaft rotation.

A NEW Lightweight Champion!

SPECIFICATIONS

Characteristics	OLD TYPE	YOUNG A-800
WEIGHT	445 lbs.	230 lbs.
LENGTH	90 in.	49 in.
TUBE DIAM.	⅜ in.	¼ in.
COOLING CAP.	Same	Same
LIST PRICE	$485.00	$370.00

YOUNG A-800 SHELL-AND-TUBE HEAT EXCHANGER OFFERS COMPACTNESS—LOW COST

There is 20% more tube surface per unit volume of space in the new Young A-800 Heat Exchanger. This has been accomplished by better utilization of space within the shell and, as a result, offers new economy in clean water cooling of oil or hydraulic fluids.

Its fixed tube bundle is another space-saving feature. The Young-designed fabricated bonnets assure smooth inlet-outlet flow with minimum impact on headers, and are removable for ease in cleaning and inspection.

Check the complete Young Line before making your next purchase.

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Heat Transfer Products for Automotive and Industrial Applications.

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Heating, Cooling, and Air Conditioning Products for Home and Industry.

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DISCOVER FOR YOURSELF NEW HEAT TRANSFER ECONOMY

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Rush me the facts about your ☐ Fixed ☐ Removable Tube Bundle Heat Exchangers, without obligation.

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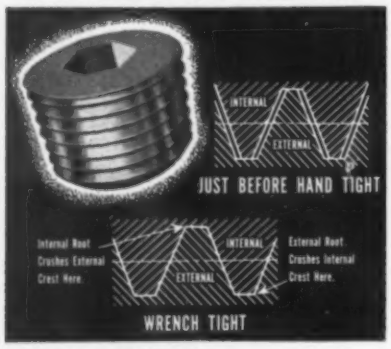
Circle 62 on Reader Service Card

UNBRAKO

DRYSEAL

THREAD

PRESSURE PLUG



SEALS TIGHT

WITHOUT COMPOUND

Unique thread design of UNBRAKO "DRYSEAL" Pressure Plugs provides positive sealing at both major and minor diameters of threads, preventing spiral leakage, even under extreme pressures. Full range of sizes from 1/16" to 1¼" N.P.T.F.

Write for Bulletin 675.

—SPS—

STANDARD PRESSED STEEL CO.

JENKINTOWN 2, PENNSYLVANIA

Hanna Celebrates 50 Years

Hanna Engineering Works, Chicago manufacturer of hydraulic and pneumatic cylinders, valves and riveters, is celebating its fiftieth anniversary this year.

The company was founded in 1901 by Elmer Ellsworth Hanna in a plant at 2059 Elston Avenue — although Mr. Hanna had begun manufacturing operations a few years earlier in a small rented space. Incorporation of Hanna Engineering Works followed in 1903.

War production in 1917 forced expansion of the company to provide for additional facilities and equipment so Hanna purchased its present plant at 1765 Elston Avenue.

Principal products of Hanna in the early years were hydraulic yoke riveters and foundry sand sifters but the list of products manufactured over the half century includes a variety of machinery.

Air cylinders and valves were first made by Hanna in 1914 following the purchase of a company manufacturing these products. The line of hydraulic cylinders was designed and developed originally by Hanna.

THE MARKET PLACE

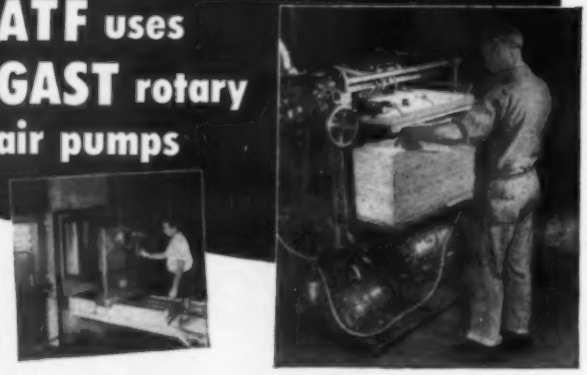
Classified Advertising

Manufacturer's Agent

To sell aviation hydraulic equipment in New York, Philadelphia and Washington area. Should have ability to supply intelligent engineering liaison between customer and manufacturer. Experience in hydraulic control systems desirable. Submit all pertinent background information. Box 5151 APPLIED HYDRAULICS.

on presses—printing frames—vacuum-back cameras—

ATF uses GAST rotary air pumps



Like American Type Founders, you may gain real advantages by specifying Gast Rotaries as components of your products.

Consider this record: For 10 years, ATF has used Gast Air Pumps on their Vacuum-back Cameras and Printing Frames.

The result? Gast dependability and performance proved itself. Now ATF is using Gast Air Pumps on many Kelly-One and Little Giant Presses. In the graphic arts industry — and in many other fields — the trend to Gast continues.

When you have original equipment problems that might be solved with air, write Gast. "Air may be your answer!"

See our CATALOG in SWEET'S FILE

Gast Application Ideas booklet — showing 26 design problems solved — sent upon request.

Original Equipment Manufacturers for Over 25 years

GAST ROTARY AIR MOTORS · COMPRESSORS · VACUUM PUMPS

(TO THREE H.P.) (TO 30 LBS.) (TO 28 INCHES)

GAST MANUFACTURING CORP., 121 Hinkley St., Benton Harbor, Mich.

Circle 60 on Reader Service Card

"M-B" AUTOMATIC

AirLine FILTER, REGULATOR and LUBRICATOR ASSEMBLY

"Sentinel of the Airline"

Also Pneumatic Grinders

"Remember, Built-in quality remains long after first-cost disappears"

FILTER element removes solids .00039 and larger. TRANSPARENT BOWL provides visibility. REGULATOR is capable of passing large volume with an unrestricted flow and minimum amount of pressure drop. Self-bleeding, compact, simple. Machined from bar aluminum. LUBRICATOR delivers desired volume of oil. Adjustable Venturi Valve permits efficient operation on broad range of volume and pressure. Bowl can be refilled without shutting off air supply. Any of these 3 devices can be used as separate units or in any combination.

Write for Literature

M·B PRODUCTS

46 Victor Ave.

DETROIT 3, MICHIGAN

Circle 61 on Reader Service Card

Sizes Go Up— Pressures Go Down

(Continued from page 36)

which operate at 1000 psi and a high pressure pump B, (2000 psi) rated at 7 gpm.

Cycle of Operation

With the press open and material in the extruder hopper, the cycle of operation is started by pressing the two start buttons. This opens the flow of pumps A1 and AF to the main ram cylinder, raising the platen at rapid approach, 375 ipm. At a predetermined point, the actuation of a limit switch drops out the larger pump capacity (A1) and the main ram cylinder is then closed at slow speed by the delivery of pump AF alone. The main ram cylinder is filled through the 8 in pre-fill valve.

As soon as the main ram is fully extended (the lower platen closing on the molds) the pre-fill valve closes, locking the oil behind the ram. At this point the high pressure pump (7gpm) is cut in and the pressure is built up to the setting of its relief valve. To accelerate the build up of pressure, the capacity of pump A2 (27.5 gpm) is added briefly or until the pressure reaches 2000 psi at which point A2 cuts out and the high pressure pump continues to operate. The auxiliary clamping and breakaway or "kicker" cylinders extend to act as additional clamping force for the injection cycle.

When the pressure is built up, the combined capacity of the double pump (A1 and A2) is diverted to the rear of the injection cylinder. A metering in type of flow control valve is used to achieve the most efficient speed of injection, very important in injection molding.

A pre-set cycle timer controls the cooling period, after which a four-way solenoid operated valve reverses the flow and the injection cylinder retracts, using the double pump capacity. When the injection cylinder is fully retracted, the capacity of the double pump is transferred to the fluid motor.

The fluid motor drives the extruder which forces the next shot of pre-plasticized thermoplastic into the injection chamber. A timer controls the extruder cycle. A bleed-off arrangement is used to slow down the extruder.

The press is held closed until the ram timer cycles. The first step in opening the press is decompression. The 500 tons of clamping pressure, maintained during the cooling period by the high pressure pump is reduced from 2000 psi to aproximately 300 psi by stopping the high pressure pump B and venting the ram cylinder through a needle valve to tank. The decompression takes

(Continued on next page)

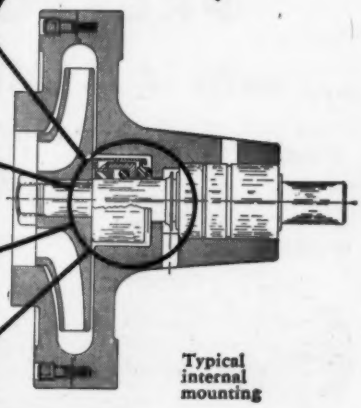
NOW! *Simplify your Designs—*

"Sealol" CB

THE COMPLETE MECHANICAL SEAL

SINGLE UNIT CONSTRUCTION

NO SEPARATE PARTS



Typical internal mounting

Construction Features

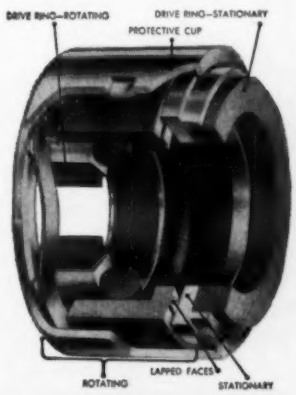
- Complete mechanical seal in one package
- Corrosion-proof materials
- Factory-assembled, factory-tested
- Lapped running faces fully protected
- Compact . . . requires minimum space

Installation Features

- Hand assembly . . . no press fits
- No special tools or skill required
- Quickly, simply installed as a unit—no loose parts
- Fits accurately without precision machining
- Running faces protected—cannot be damaged by mishandling
- Internal or external mounting

Operation Features

- Permanent sealing—no packing to adjust—no scored shafts
- "Sealol" balanced-pressure design—maximum seal life
- Seals wide variety of liquids
- Minimum frictional drag—low torque
- Pressures in excess of 100 psi . . . speeds to 10,000 RPM

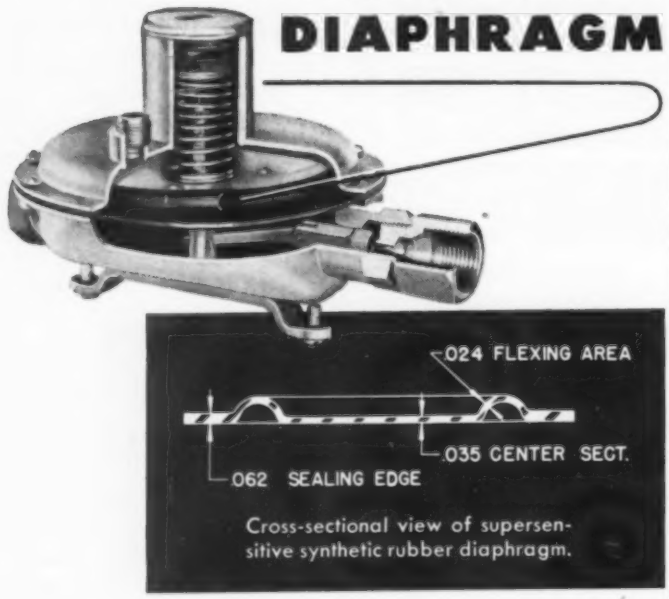


"Sealol" CB Seals are recommended for pumps — water, oil, boiler feedwater, gasoline, aviation fuel—for compressors, gear boxes, washing machines, etc. For "Sealol" Drwg B-7100 giving complete dimensional information and for engineering recommendations and bulletins, address Sealol Corporation, 45 Willard Ave., Providence 5, R. I.

SEALOL

Chicago • Cleveland • Detroit • Los Angeles
New York • San Francisco

CONSTANT DELIVERY PRESSURE ...with a LINEAR PRECISION MOULDED DIAPHRAGM



Cross-sectional view of supersensitive synthetic rubber diaphragm.

TYPICAL is the result obtained with the LINEAR Diaphragm, shown above. Precision moulded to a .062" edge, .024" at the flexing area, and .035" in the center section, this super sensitive diaphragm assures a consistently uniform delivery pressure over a wide range of inlet pressures.

Detailed and expert attention to the need for minute variations in cross-sections and radii . . . coupled with application experience in the selection of specific materials . . . has enabled LINEAR to produce precision-moulded diaphragms with a rolling action that eliminates stresses, reduces hysteresis and increases life. Thus, LINEAR Diaphragms offer advantages that cannot be achieved with flat diaphragms . . . frequently at lower cost.

Produced under rigid supervision and held to the closest of tolerances, every single LINEAR Diaphragm can be depended upon . . . mighty important in these days of critical material shortages. For a lower rejection rate and easier installation, it will pay you to consult LINEAR during the design stages of your diaphragm applications.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

the stretch out of the press before the pre-fill valve is opened.

A pilot choke on the pre-fill opening valve allows the press to open very smoothly.

The press is de-compressed but still closed. A solenoid operated four-way valve reverses the flow of pump AF, retracting the "kicker" cylinders and achieving a slow breakaway for the main ram. As soon as the main ram has started to lower (retract), the combined capacity of the double pump (A1 and A2) and that of the high pressure pump B is added to the capacity of pump AF for rapid return of the ram.

Near the end of the retraction stroke, which opens the platen, limit switch activation cuts out the double pump. The stroke continues at very slow speed with the two small pumps, AF and B. At the slow down point the part or parts are ejected from the mold proper and the operator removes the finished piece from the press.

The injection cylinder is controlled by flow control valves; ram, clamp and extruder timers are preset to balance out operation smoothly. A bleed-off line is used to slow the extruder speed.

Limit switch actuation controls the flow to and from the main ram and the injection cylinder; all of the valves are solenoid controlled for automatic single cycle operation.

Print on Film With Stepless Control

(Continued from page 39)

and moves oil back to tank from port A to T. Oil from port B is blocked by the relief valve which protects the fluid motor from overload. Being set at 1000 psi, the relief valve will unload pressure to tank through port B if the load on the fluid motor becomes excessive.

This circuit also provides for quick dynamic braking of the fluid motor. When valve 9 is moved to the third position port B is connected to tank and oil from port A is blocked by the relief valve trapping the oil to stop the motor. This position provides a quick stop whereas neutral position, where all ports are open to the tank, will give a coasting stop. Note that the circuit is designed for one direction of fluid motor rotation.

A hydraulic oscillator 13 actuates the color doctor blade which is on the bottom and to the rear of the print roller. Two doctor blades are used; one oscillating for color cleaning and one stationary for lint. The oscillator speed is independent of printer speed and the number of oscillations per minute may be varied while the machine is in operation.

The circuit readily shows the simplicity of control and indicates how the circuit components are fully protected and easily adjusted to provide consistent, trouble-free operation.

POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

R. C. Flood

Russell C. Flood has been appointed assistant secretary of **A. Schrader's Son Division of Scovill Manufacturing Company.** Flood joined the company in 1930 having specialized in the accounting and financial phase of the business since that time.

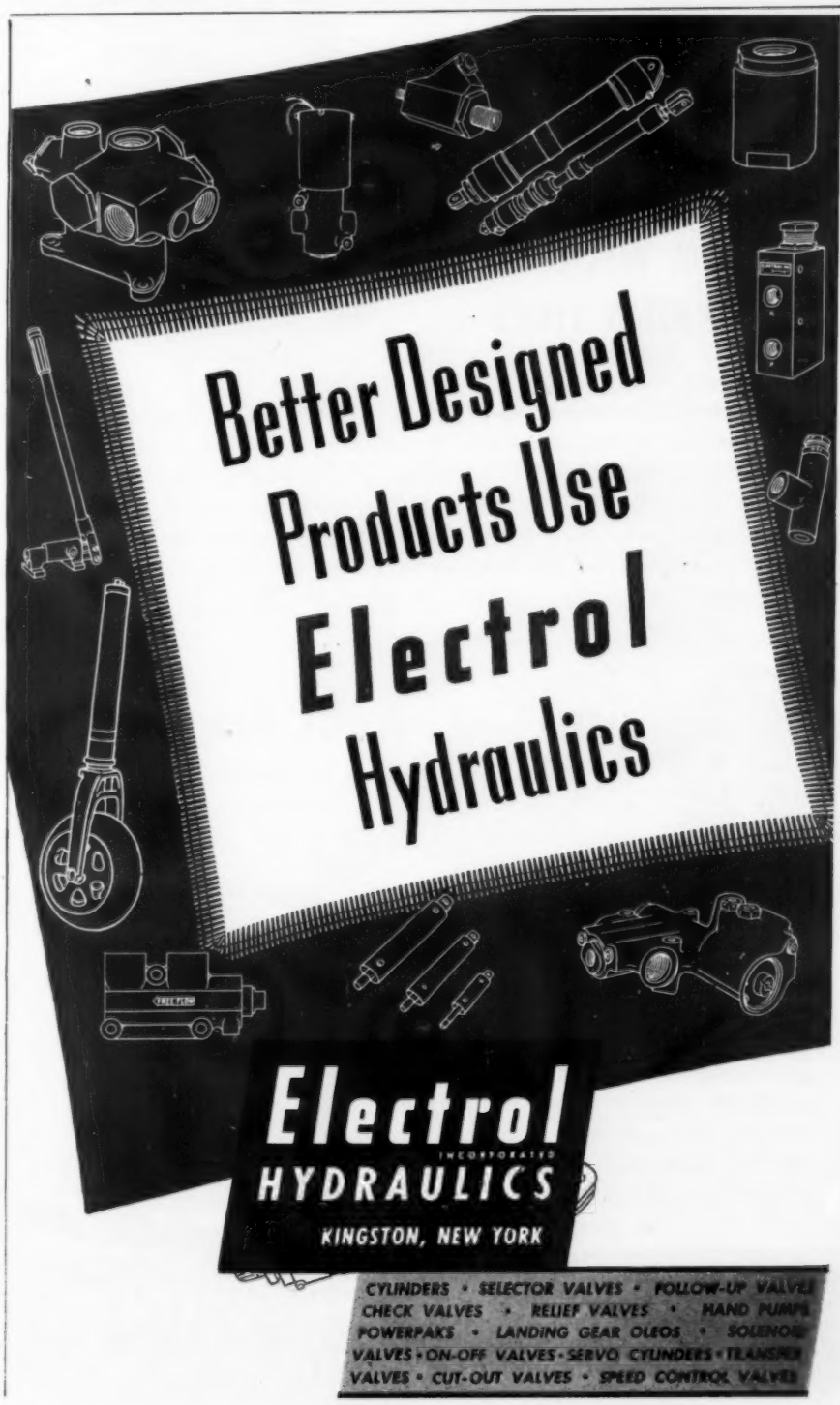
John Mikulak has been appointed assistant to **L. C. Ricketts,** vice president in charge of manufacturing of **Worthington Pump and Machinery Corporation,** Harrison, N. J.

Walter Ernst has been engaged as a consultant to the Hydraulic Engineering Staff of **American Engineering Company.**

The **Aro Equipment Corporation,** Bryan, Ohio, has elected **R. W. Morrison** and **J. P. Johnson** to fill newly created directorships. Both Morrison and Johnson are vice presidents of the corporation.

A new development and manufacturing corporation specializing in valve assemblies has been established under the name, **Missile Valve Company,** 8945 Venice Boulevard, Los Angeles 34, California. The company offers service on special design and production of such items as pressure regulators, relief valves, shut-off valves or check valves. **Roland Saye** is president of the new organization.

Aeroquip Corporation has purchased **Metalco, Inc.** Operation of the company will be continued as a wholly owned subsidiary of Aeroquip, with **Don Mortlock** as vice president and general manager. **Kenneth Meyerholtz,** chief production engineer and plant superintendent of Aeroquip has been elected president of Metalco. Metalco has leased a plant in Cheboygan, Mich. which will more than triple present floor space.



LOW COST PROTECTION WITH GENERAL FILTERS

ALL-WOOL CLEANABLE CARTRIDGE REMOVED FROM BOTTOM WITHOUT DISTURBING LINES

Manufacturers of machines using lubricating or hydraulic oils can assure their customers of longer machine life and lower maintenance costs by specifying General AF-500 Filters. They can be installed with inlet at the top or bottom for better space and piping accommodations without altering flow rate or efficiency. Removes solids as fine as five microns and has a capacity of 15-20 gallons per minute depending upon viscosity.

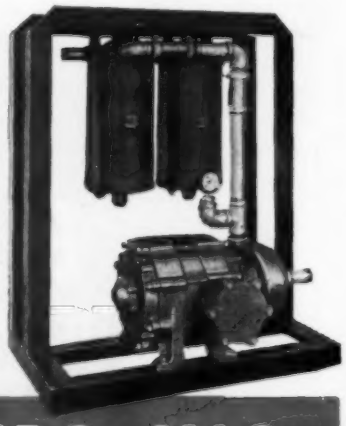
Write for complete specifications and prices. Let us show you why the big industrial users specify GENERAL.

FINEST ALL-WOOL CARTRIDGE

This all-wool felt cartridge is the finest money can buy. Removable from the bottom without disconnecting any lines. Cleanable in minutes in any suitable solvent.

MODEL AF-2000A FOR TANK APPLICATION

For pumping from a central supply tank or for cleaning vats and tanks the model AF-2000A combines a pump and double filter. Capacity up to 45 gpm depending upon pressure and viscosity. Available with either explosion or drip-proof motors.



GENERAL FILTERS, INC.

12890 WESTWOOD • DETROIT 23, MICH.

Election of **Edward O. Boshell,** as chairman of the board and president of The Westinghouse Air Brake Company, and its subsidiary, The Union Switch and Signal Company, is announced. Mr. Boshell has been elected a director of both Pittsburgh companies. **A. N. Williams,** who has served as president of both companies since 1946, has been elected vice-chairman of the board of the two organizations. **Herbert A. May** has been elected senior vice-president.

E. O. Boshell

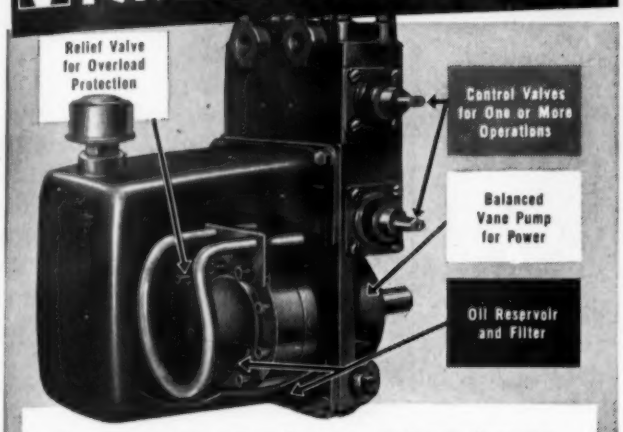
F. C. Winter, manager of stors for **Worthington Pump and Machinery Corporation's** Harrison Works will also act as the corporation's manager of Defense Procurement, and **C. W. Camp,** electrical engineer in Worthington's sales department, has been named assistant corporation manager of Defense Procurement, with headquarters at Harrison.

Construction of a new parts plant now being erected on a 17 acre site in Des Plaines, Illinois, a suburb of Chicago, is announced by **Ellwood G. Peterson,** president of **Hannifin Corporation.** The modern, one story factory building is the first of a series of buildings planned by Hannifin for this location. This initial unit will cost over $350,000 and contain approximately 40,000 square feet.

Upgrading of **M. A. Moore** to the post of Eastern division manufacturing and sales manager of the **Double Seal Ring Company** was announced by W. T. Green, vice president and general manager of the company. Moore, who was formerly Double Seal's sales

Circle 67 on Reader Service Card

Hydraulic VICKERS POWER PACK


Relief Valve for Overload Protection
Control Valves for One or More Operations
Balanced Vane Pump for Power
Oil Reservoir and Filter

The Power Pack offers designers and manufacturers a proven and dependable source of hydraulic power in a single compact "package". Hydraulic balance, automatically controlled operating clearances, and built-in overload protection are among the many advantages that make the Vickers Power Pack an outstanding hydraulic equipment value. Saves labor and reduces cost on agricultural implements, construction machinery, materials handling equipment, and industrial machinery.

VICKERS Incorporated • *DIVISION OF THE SPERRY CORP.*
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Circle 68 on Reader Service Card

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M-2 Bronze Body Diaphragm Valves **M-3**

for **air conditioning, packaging, refrigeration, air, printing equipment, etc.**

The "M" Series valves are approx. 4⅝" high, yet have extremely fast action and large capacity for liquids, air and inert gases! They have soft insert seats to prevent leakage — will operate in any position — nylon fabric coated diaphragm for long life — max. power consumption 10 watts — continuous duty! **M-2** two-way normally closed — 5 to 150 p.s.i. — port size ⅜" or ½"; orifice ⅜" — pilot operated. **M-3** three-way normally closed, three-way normally open or directional flow — 20 to 150 p.s.i. — port size ⅜" or ½"; orifice ⅜" — pilot operated. Special models available.

Write for Bulletin No. 493

Skinner ELECTRIC VALVE DIV.
THE SKINNER CHUCK COMPANY
142 Belden Ave., Norwalk, Conn.

SAVE UP TO 85% in WAR SURPLUS HYDRAULICS

SPECIAL BARGAIN
#29 HYDRAULIC CYLINDER

Gives 20,000 lbs. thrust (push pull) using 1500 PSI line pressure as obtained from our hyd. pumps. Or will produce 40,000 lbs. thrust with 3,000 lbs. line pressure. CAN ALSO BE OPERATED ON LOW PRESSURE AIR SYSTEMS. 4" Bore, 1¾" dia. piston shaft, 18" stroke, length 30½". Equipped with ball bearing loaded clevis type mounting and swivel type high pressure steel pipe bracket for easy use. Ideal for road farm and shop machinery, presses, etc. Cost Government $390.00 . . . . . NOW **37.50**

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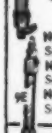
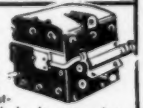
NO. 3A – Bore 1½", Shaft ½" Stroke 5", Length 10½" **5.75**
NO. 9E – Bore 1-3/8", Shaft 1" Stroke 15-5/8", Length 15½" . . . **8.50**
NO. 35 – Bore 1½", Shaft 1" Stroke 26", Length 23½" **15.75**



HYDRAULIC TRANSMISSION



Self contained, 2 H.P. constant torque at all speeds with variable volume reversible, piston pump (controlled by outside lever.) supplying piston hydraulic motor. Automatic pressure, Dash pot for smooth control. Power output R.P.M. – 0 to 1/3 input R.P.M. in both directions. Input R.P.M. 1800 continuous 4000 intermittent. Dash pot can be removed for greater R.P.M. Ideal for Lathes, Duplicator Setup on Mills, Conveyors, Small Cars, Drives, Gearing, etc. Includes 2 - 4" Spline Shafts for input and power take-off. Cost Government approx. $400.00 **37.50**

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1/4" Tube Size – 7/16 x 20 Thread – 16" long with Male and Female fitting at either end. . .95¢ each.
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3/8" Tube Size – 9/16 x 18 Thread – 20" long with Female fitting at both ends. . . . . $1.90 each
Same as above but 63" long. . . . . $3.75 each
1/2" Tube Size – 3/4 x 16 Thread – 24" long with Female fittings at both ends. . . . . $2.65 each.
Same as above but 67" long. . . . . $3.75 each.
5/8" Tube Size – 7/8 x 14 Thread – 15" long with Female fittings at both ends. . . . . $2.25 each.
Same as above but 36" long. . . . . $2.95 each.

HYDRAULIC PUMPS

ANGLE PUMP Positive displacement type, angle piston. Displaces .507 cu.in. per revolution. Has capacity of 6 gal. per minute at 3000 RPM at 1500 PSI continuous 1875 for 15 seconds. Operating speed of 3750 RPM, intermittent maximum 4500 RPM. Rotates to the right only. . . . . NEW **17.50**

P-3 STRATO POWER PUMP With built-in variable flow control valve in head. Positive displacement piston type. Displaces .450 cu. in. per revolution. Two gal. per minute capacity at 1500 RPM at 1250 PSI. Pressure limit, 1250 PSI continuous. 1400 PSI for 15 seconds. Operates at 3750 RPM, intermittent max. 4500 RPM. Rotation either direction without adjustments. NEW **17.50**

FOUR WAY VALVE

V-2B – Poppet Type. Off at neutral position. 3/8" AC Tube Ports – (9/16 - 20) thread. P.S.I. 1,500 . . . . . **4.75**

V-17 – Poppet Type. Pressure balanced. Offset neutral position. Piston type with built-in relief valves for limit of cylinder strokes. ½" Standard pipe inlet & outlet ports. ½" AC tube to cylinder (⅝" - 18) thread tapped ports. NEW **8.75**

GEROTOR TYPE PUMP

Logan Gerotor type. For operating hyd. systems on tractors, trucks industrial machinery, etc. Delivers 8 GPM, at 1200 RPM, at 1000 PSI with 5 HP. Can also be used as Hydraulic Fluid Motor. Has 3/8" stnd. pipe ports, ½" splined shaft for pulley or direct attachment. 5½" dia. x 7" lg. Used but guaranteed condition. Now ONLY **22.50**

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PEMACO HYDRAULIC AND AIR CYLINDERS with the NEW Cartridge Type Packing Gland

Designed to J.I.C. Hydraulic Standards

Pemaco Hydraulic Cylinders are soundly engineered—give long life and top performance. The steel ram is hardened to 50.C Rockwell, ground and lapped. NOW the Pemaco has the first self-contained Cartridge Type Packing Gland.

This new Pemaco "EASY-PAK" Gland is designed to comply with J.I.C. Standards. It combines double bearing surface, low friction ram seal, and a ram wiper into a single compact unit. Easily maintained, the Pemaco "EASY-PAK" Cartridge Type Packing Gland can quickly be replaced in most cases without removing the cylinder from the machine — and by inexperienced help — greatly reducing machine down-time.

Pemaco "EASY-PAK" Cartridge Type Packing Glands are manufactured for both hydraulic and air cylinders.

PETCH MANUFACTURING COMPANY

Write for complete information and engineering data.

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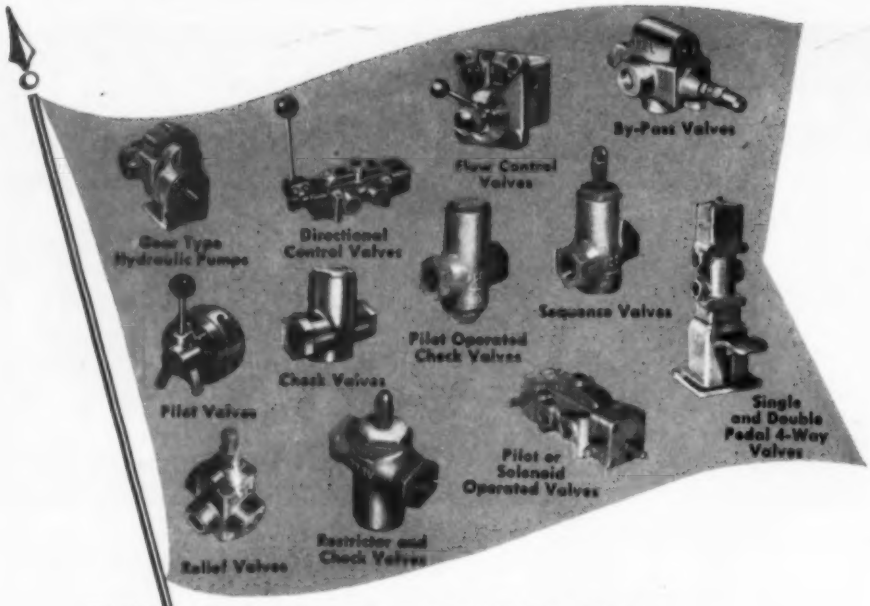

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and service representative in Maine, Vermont and New Hampshire, has assumed his duties in the company's Eastern division office in New Rochelle, N. Y.

V. N. Thacker

Electrol Incorporated announces the appointment of **Vic N. Thacker** as production manager. Thacker was formerly associated, for 3 ½ years, with Fairchild Aircraft as equipment engineer.

American Engineering Company has appointed **Compressed Air Products,** 400 Third Avenue, Brooklyn, New York, 1977 Springfield Avenue, Maplewood, New Jersey and Harkness Road, Amherst, Massachussetts as their representatives for the sale of the Hele-Shaw and Hydramite Pumps in Northern New Jersey, Metropolitan New York and the entire New England territory.

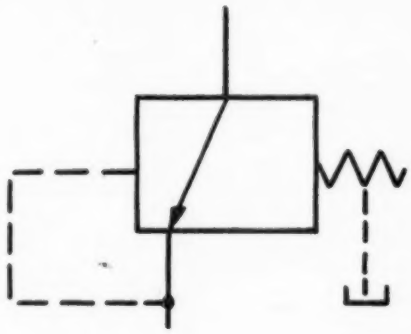
S. S. Wolff, formerly with Century Electric Co., St. Louis, has become associated with the **American Safety Table Co.,** Reading, Pa., as chief engineer.

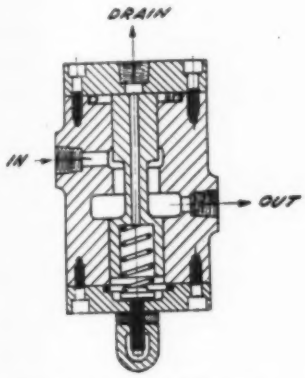
M. L. Sheehan has joined **The Parker Appliance Company,** Cleveland as industrial sales engineer representing the company in Dallas, Texas, serving industrial firms of the south central states.

James H. Stewart, formerly manager of the hydraulic division of B. F. Perkins & Son, Inc., has joined **Compressed Air Products** heading their New England sales office in Amherst, Mass.

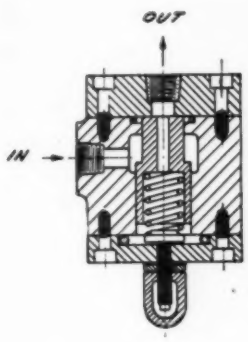
Know Your Component Symbols

JIC Symbol
Reducing Valve





Constant Reduced Pressure



Constant Reduction

PRESSURE REDUCING VALVES

Hydraulic Series

The fifth in a series showing the symbol and a typical schematic of the valve it represents.

Pressure Reducing Valves — When a lower pressure, than that which is generated by the pump, is desired in a portion of the hydraulic system, a reducing valve is used. For example, where one pump is supplying two cylinders each requiring a different pressure to perform its work, a reducing valve used in the pressure line to one of cylinders will provide the required pressure. The second cylinder may be powered directly by oil from the pump.

Two basic types of reducing valves are used. One supplies a specified reduced pressure regardless of pressure generated by the pump (so long as pump pressure is above the required reduced pressure). The second type maintains a fixed amount of reduction resulting in a reduced pressure which varies with system pressure.

The JIC symbol indicates that reduced pressure is developed by positioning a spool held between spring pressure and oil pressure from the outlet line. Design of the spool determines the type.

Standards File Sheet

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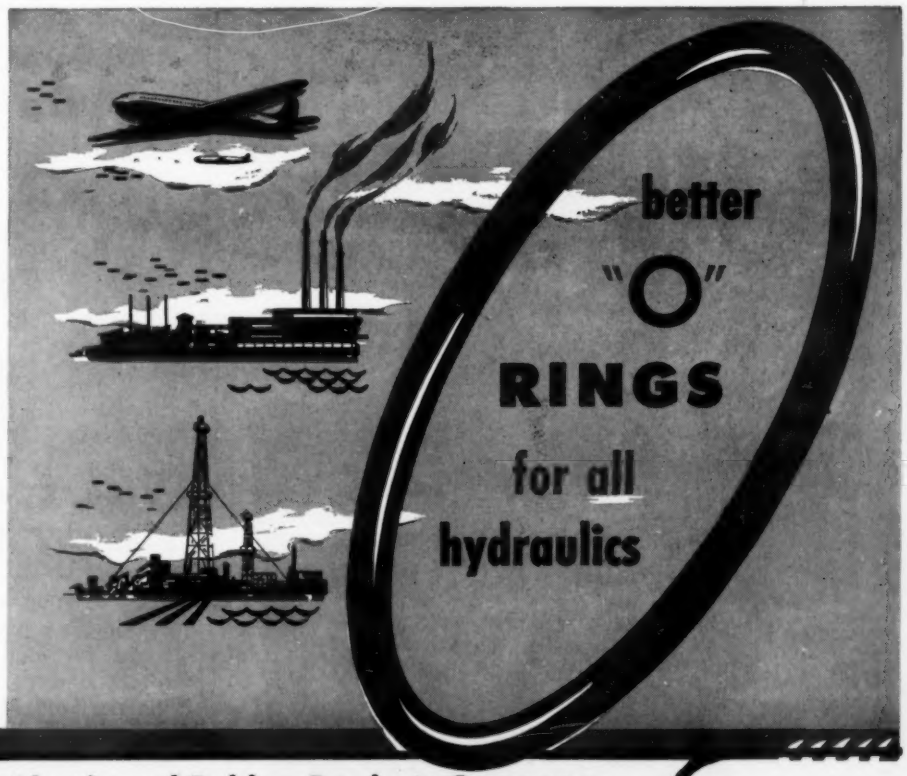

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Plastic and Rubber Products Company

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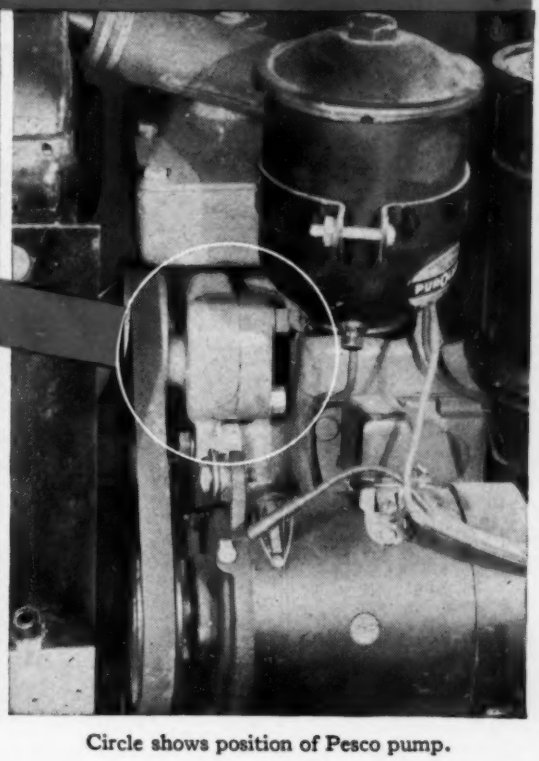
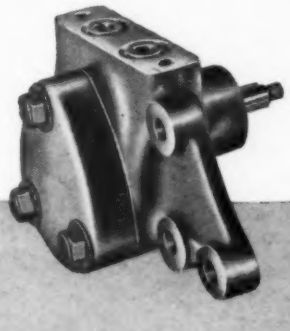
Circle 74 on Reader Service Card

Another Job for Pesco HYDRAULIC MUSCLES

"The sensitive response of the hydraulic system permits such trigger-fine adjustment that operators are loud in their appreciation," says Massey-Harris . . . *the sales power of hydraulic power in action.*



Circle shows position of Pesco pump.



Pesco pump designed for Massey-Harris Pony tractor. Capacity: 2.5 g. p. m. @ 2880 r. p. m. @ 1000 p. s. i.

Pesco *Dual Purpose* Pump Eliminates Extra Power Shaft on Massey-Harris Pony

The problem was to eliminate all unnecessary weight and cost and save space on a small tractor.

So Massey-Harris tractor engineers and Pesco hydraulic engineers teamed up . . . together came up with a specially designed dual purpose hydraulic pump to serve as both pump and fan bearing mounting.

Result: less space and weight required . . . necessity for an extra motor power shaft is eliminated.

Such teamwork between Pesco and client engineers is frequent. Matching hydraulic know-how and skills with the engineering knowledge of a manufacturer's engineering staff is the way we at Pesco like to work. It is teamwork that puts the sales power of hydraulic power to work to full advantage for our customers.

If you have a problem in hydraulics Pesco engineers will gladly co-operate with your engineers to solve it. Write today.

engineering Pesco production

PRODUCTS DIVISION

BORG-WARNER CORPORATION

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Circle 2 on Reader Service Card

Guard Your Family STRIKE BACK!

GIVE to Conquer Cancer

IF SOMEONE IN YOUR FAMILY HAD CANCER, you would do anything . . . everything that would help. And today there is so much that you can do to help. Tens of thousands of families just like yours meet cancer every year and triumph over it. But we are still losing too many men and women we love.

Doctors can now cure half of those who develop cancer if the disease is diagnosed in its early stages. Yet in 1950 some 210,000 families lost a father, a mother or a child to cancer. Many of them—probably 70,000—could have been cured.

To save more lives, we all must help.

Your gift to the Cancer Crusade will help guard your family by providing more research, more life-saving education, more training for scientists and physicians, more equipment, more services for those already striken with the disease.

Cancer is man's worst enemy. Striking back at cancer costs money. Any contribution is welcome but, the fight against this major threat deserves major support: dollars—tens—twenties—hundreds of dollars. Will *you* help?

AMERICAN CANCER SOCIETY

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